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Owing to the large bulk of the present number, the Index for the volume just completed will be reserved for distribution in the issue of next week.

ELECTRIC LIGHTING IN NEW YORK.

The city of New York will always be historical ground for the electric lighting art, not only on account of the early work done here in commercial arc lighting, but because here a great many of the fundamental problems in incandescent lighting were first worked out in connection with the old Edison Pearl Street Station. Thirty years nearly of arc lighting and almost a quarter of a century in incandescent work have seen changes that can but be described as tremendous, yet as we describe this week the great Waterside station of the New York Edison Company, a continuity of influence and aim is felt and realized amid all the confusing technical, financial and industrial developments that have been crowded into the period. We can personally look back over the whole evolution, revolution and growth, and see in it but the promise of even greater results in the future. Out of a welter of systems, competitions, methods, voltages, apparatus, companies, has emerged one splendid comprehensive plan, one ideal, one leadership, directed specifically to the purpose of affording uniform service throughout the Island of Manhattan. This result had to be—it had to come, whatever the difficulties and obstacles—and now that it is here every citizen of New York, with all who are interested in the progress of electric lighting, is deeply concerned in what has happened.

This magnificent Waterside station represents a stage in the art. It is neither perfection nor finality, but it is a splendid realization of the best existing practice and the highest current theory, and deserves intimate study for its own sake. We illustrate and describe the plant just as it goes into service, and yet the demands for electricity in New York for light, power and heat increase so rapidly, the complete station which began its career this Christmas will have all it can do next Christmas to meet the call, with every unit going. In such conditions it is easy to see not alone the great future for electrical applications but the onerous problems to be met by the engineers and capitalists who propose to serve three million people.

ELECTRICAL PROGRESS DURING 1901.

Although the past year has not witnessed any startling electric novelty, yet it has fostered a remarkable development in many directions. Particularly active departments of electric industry have been electric railways, water power transmission, telephony and wireless telegraphy. In electric railways there has been a steady development of new lines, and of improved electric schedule times upon existing tracks. In water-power transmission systems there has been a steady increase in the powers utilized, and in the pressures employed, the existing limit being 60 kilovolts. Along with this development there is a greater confidence in the reliability and certainty of electric power transmssion under pressures that until recently have been considered as very high. In telephony there has been a very considerable extension of existing subscribers' systems, the gradual substitution of the central battery at exchanges, for the scattered batteries at subscribers' stations, and considerable improvement in exchange switchboard design and installation. By the principle of loading long aerial lines or cables with inductance at suitable intervals, the pre-existing limitations of long-distance telephony have been

greatly widened, and it would seem as though, eventually, commercial telephony might become possible across the length and breadth of the North American continent, and perhaps across the oceans.

Wireless telegraphy has made considerable progress over the ocean, and a number of ships, as well as shore stations, have adopted it. It seems to be only a question of time when every important lighthouse and signal station on the coast will be equipped with wireless apparatus, and every important vessel on the ocean will be likewise enabled to maintain communication for long distances at sea. Not only in the practical applications, but also in the knowledge of the science of electricity, a steady development has been and is taking place. A mere glance at the articles of technical journals, on the one hand, shows the steady gain and improvement of technical knowledge among specialists, while a glance at the nature and number of articles in semi-popular literature, shows how widespread is becoming the more general knowledge of the elements of electricity and magnetism among the masses of the people by comparison with the corresponding conditions a few years ago.

The amount of capital invested in electric industries continues steadily to increase, on the one hand, while, on the other hand, the applications of electricity are becoming more widely understood and more intelligently handled. Whereas only a few years ago it was difficult to find a workman who could look after electric motors properly without a special course of training, it is now becoming more frequently the rule to find experience in the care and application of electric motors and generators among comparatively unskilled workmen. In every direction electricity is becoming year by year of greater value and importance to the world.

Automobile Efficiencies.

Although the electric automobile has apparently been getting the worst of it in some quarters during the past twelve months, and some reforms and improvements over former defective constructions are needed, the outlook is by no means discouraging. As we have said before, the electric vehicle will win out in the end for city use. Abundant support for this opinion can be found. But this consolation lies not so much in what these vehicles have done as in what they have not done. If the art of electric vehicle building had reached the point where it was not easy to see directions in which improvements could easily be made and the results were no better than the average attained to-day, it would be discouraging indeed. But with such evident defects as are to be noted on so many of the earlier vehicles, the only wonder has been that the results are as good as they have been. That improvement is at hand is evident.

The shortcomings of the automobile storage battery have been too well debated to need recounting, the principal charges against it being its uncertain mileage due to deterioration and its high maintenance cost. It has commonly been assumed that the only weak point of the electric vehicle of whatever kind was in the battery, and that the electrical and mechanical efficiency left little room for improvement. How far from the truth this latter statement is, only those know who are intimately connected in a technical way with the electric vehicle business. When vehicles of the same weight and speed vary so widely in electrical and mechanical efficiency that one will require 50 to 75 per cent more energy than another, something is wrong. And yet this, we are informed by engineers who are in a position to make accurate observation, is a common occurrence. A battery manufacturer with a reputation for batteries of great mileage capacity per pound smiled knowingly the other day when the subject was broached, and remarked that batteries got both the blame and the credit for many things the battery maker has nothing to do with; that automobile builders would do well to look into the efficiencies of motors and running gears as well as search for better batteries. Coming from a battery maker, who might easily make temporary capital out of ignorance on the part of automobile builders and users as to some of the secrets of big mileage tests, the statement is significant.

This gentleman, however, took the broad-minded view that the more that is known about motor and running gear efficiencies, the better it will be for the battery maker in the end, even if he does have to divide the credit for large mileage on one charge with the vehicle maker. Hence we understand that he is about to proceed with a campaign of education and practical demonstration on efficiencies. It is, of course, true that the vehicle that will give the highest possible efficiency between the battery terminals and driving wheels will not be commercially practical because of structural weakness, but that there is a great deal of room to improve the average efficiency of electric vehicles as they have been commercially turned out there is little doubt. So far in these remarks we have dealt with the situation as it is, but obviously the availability of the Edison battery this year would in itself, while helping the art enormously, not cure any of the drawbacks due to the low efficiency of motors and gears.

The Metric System of Weights and Measures.

It will probably interest our readers to learn that two bills have been introduced within the last few weeks into the House of Representatives, for the adoption of the metric system of weights and measures in the United States. These bills are marked H. R. 123 and 2054, respectively, and have been referred to the Committee on Coinage, Weights and Measures. The bills are alike remarkable both for their brevity and for their comprehensiveness. Both propose (1) that after a certain date all the Government departments of the United States shall be required to employ the metric system of weights and measures exclusively in all departmental work, except in the survey of public lands; (2) that after a certain date the metric system of weights and measures shall be the legal standard of weights and measures in the United States. The only essential difference between the two bills is as regards the dates involved. One calls for the 1st of January, 1903, as the date of Government adoption, and the 1st of January, 1904, as the date of universal legalization. The other bill makes both these dates the 1st of July, 1902.

All those connected with electrical industries are specially interested in the general introduction of the metric system of weights and measures, for the reason that all the units employed in electrical engineering are based upon the metric system and are in conformity therewith. Electromagnetic units may be said to form an extension of the metric system in this direction. It is impossible to compare the barbarous and incoherent assortment of heterogeneous weights and measures in force in this country with the simple and connected system of metric weights and measures in force on the continent of Europe, without being impressed with the immense aggregate amount of unnecessary labor which is imposed upon the American people in learning to weigh, to measure, and to compare quantities; as well as the large amount of impediment that the existing ridiculous system introduces in the way of attaining all quantitative knowledge. Every reasonable person will admit the great advantage which the money decimal system of this country possesses over the money non-decimal system of Great Britain. The advantages of the metric system of measures over the non-metric system of measures is, however, still greater than that which exists in the case of moneys. It is a scandal that this country, in establishing good government in Cuba, Puerto Rico and the Philippines, should be instrumental in so far subverting the cause of education as comes through replacing in those

countries the pre-existing simple metric system by the ponderous system still existing here.

Consequently, while nearly every intelligent individual will naturally be in favor of introducing the metric system, which system is now in vogue through the entire scientific world, and in a large portion of the commercial world, the question arises as to how the change should be brought about, because the change necessarily involves labor and expense, and the injury inflicted upon the public by a sudden transition to the metric system might be much greater than the injury which exists in perpetuating the existing system. In the nature of things, a number of years must elapse before the existing system of measures can be entirely superseded by the international system. Under the new regime, however, education will be facilitated, statistics of all kinds simplified, foreign trade aided, and mental processes of all kinds abridged and clarified. It would seem that the first great step to be desired is the adoption of the metric system by all the United States Government departments. This change would involve a gradual adoption by the people without inflicting injury upon any industry. All persons having dealings with the Government would speedily become acquainted with the value and use of the metric system, and would in turn act as teachers of that system to those within their own sphere of influence. At some date after the exclusive adoption of the metric system by the Government, the system could be exclusively legalized, but it is more difficult to decide as to when this latter step could be taken without involving heavy expenditure upon the makers of tools and machinery. The introduction of the new system should be carried out in the country in such a manner that all new tools as needed should be made with a view to the metric system, without necessarily causing the existing tools and machines to be immediately abandoned.

THE FUTURE OF THE ELECTRIC RAILWAY.

The last two or three years have been rich in experience in electric railroading, and the most striking thing about it all is the almost entire lack of sensational features such as might not unnaturally have been expected. All the startling developments, such as get widely heralded in the daily press and promise to turn things topsy-turvy if they materialize, have been initiated on the other side of the water. Meanwhile, the progress here has been one of steady growth, each new road working with a little freer hand and on a little larger scale than its predecessors. By far the most interesting line of advance has been among our interurban roads of the larger class. Starting out as tramway extensions, electric interurban roads have by almost imperceptible degrees grown into a place which is in great measure unique. They run long and heavy cars quite comparable with ordinary passenger coaches, at speeds similar to those customarily employed in ordinary railroading, with an approximation more or less near, to every-day railway methods. The modern interurban road, therefore, occupies a somewhat anomalous position. It practically deals with the passenger traffic of an ordinary steam railroad, while in most instances it is ostensibly still a tramway using public roads and streets to a certain extent, having grade crossings without material restrictions, and in general enjoying the privileges and immunities of street railways while doing the work of a steam road so far as public convenience is concerned.

Utility is the strongest argument that can be brought to bear upon the public, and modifications in this simple but evidently temporary stage of growth have come spontaneously and from engineering considerations. It has not taken long to find out that when quick transit between two cities is established and long and heavy cars are operated, the track must be of a correspondingly solid and reliable character. So it has come to pass that the average new interurban line uses a heavier rail and a more substantial roadbed than is ordinarily found on anything but important lines of steam railroads. By reason of this and of using wheels to match, the question of suitable arrangements within the urban termini has risen to great importance. The situation has been widely discussed among the street railway men, and opinion seems to be divided as to whether Mahomet should come to the mountain or the mountain to Mahomet—whether urban roads should prepare for the extra strains of interurban rolling stock or whether a line should be drawn between urban and interurban traffic and a change of cars enforced at the city limits. On broad general principles a change of cars is always and everywhere a nuisance to be averted; but while urban systems might reasonably be expected and required to permit cars similar to their own to use their tracks they can hardly be forced to change their rails and roadbeds because an outlying line happens to be running extra large cars that require such a change. Thus it happens that a natural process of differentiation is tending to separate the larger interurban roads from urban precedents, and when this becomes more complete we may fairly expect some developments in the line of speed that will be well worth seeing. Instead of getting the high speed electric road at a leap, as would have been the case had the late Dr. Adams succeeded in putting through his St. Louis-Chicago line, we are likely to get it by a process of evolution, perhaps with a hearty lift from our friends at Zossen.

The requirements of heavier cars and larger traffic have called steadily for more power, and the outcome has been distribution by polyphase current and new methods of arranging the working conductors. The third rail, tried at first with some misgivings, has worked its way into considerable use, and its bearing upon future work is one of the open questions of electric railway engineering. On elevated lines it appears to give excellent service, but on surface roads its merits are certainly open to question when long distances are attempted. It is too early to forecast its fate. It may be, as in the case of the electric slotted conduit, merely a question of reasonable care and expense. The third rail has never been, to our knowledge, tried with anything like proper precautions to prevent leakage and to render the system safe. There is much to learn here as there was in the case of the conduits. An adequately drained roadbed, a suitably insulated rail, and, above all, proper protection for the rail so as to lessen the danger to life which is now altogether too considerable—all these are necessary before the status of the third rail can be determined.

The experiments now being tried at Zossen are likely to have a very important bearing on long-distance and high-speed work of every kind, and if the requisite energy can readily be taken from overhead conductors and the motor regulation proves successful, a long step will have been taken toward clearing up some existing difficulties. If the interurban road were inseparable from the urban networks at the termini, then the engineering methods adapted for the one must be suitable for the other. When, however, interurban systems by the nature of their growth come to further and further separate themselves from tramway methods, they may thereby open the way for some very radical changes. The necessities of urban termini are as severe a drag on the full usefulness and development of fast interurban lines as the old scheme of pulling cars through the streets with mules was upon the early steam railroads. Both the steam and electric systems have escaped their difficulties by cutting loose from confining precedents. The interurban road is with us to stay, and it must, so to speak, stand upon its own legs. If we are to have fast electric intercommunication we must not try to compromise with ordinary street railway methods.

Nerve Phenomena and Electricity.

The newspapers of Jan. 1 contain a sensational account of some discoveries as to the phenomena of nerve action, alleged to have been made by two Chicago professors. In some of the accounts given, Dr. F. A. Mathews, of Chicago University, is stated to be the discoverer, and other accounts give the credit to Professor Jacques Loeb, of the same university. The name of Dr. Loeb appeared some months ago in connection with what was claimed to be a startling discovery concerning the physiological action of sodium, which discovery newspaper writers epitomized in the phrase "Sodium is Life."

According to the present discovery, electricity is the controlling factor in nerve action. It is stated that nerves consist of a colloidal solution, the colloidal particles of which carry positive electrical charges. The nerve is stimulated by the action of ions—defined as electrically charged atoms or groups of atoms, which bear negative charges—and the stimulating of any chemical compound depends upon these negative charges. Ions having one charge are less efficient than those having two or three charges. A one-charged ion, such as sodium, is less poisonous than a three-charged ion, such as iron. The colloidal particles of nerves are held in solution by positively charged ions. These facts, it is stated, show that chemical stimulation is identical with electrical. When in any part of a nerve negative charges are in excess, the nerve is stimulated, the stimulus always arising at the cathode or negative electrode. All positively charged ions diminish irritability, and negative ones increase it. This is claimed to explain electrotonus, as the irritability of the nerve is increased near the cathode and reduced near the anode.

The stimulating action of any ion or the poisonous action of any kation is stated to be a function, first, of the number of charges rotating about the atom; second, of the rate of the rotation of these charges, and, third, of the circumference of their orbits. It is stated that the electron rotates about a fluorine atom about twice as fast as about a chlorine atom. In conclusion, it is said that chemical stimulation is, by the electromagnetic theory of light, shown to be identical with the stimulation of light waves. The stimulation of any anion increases as the spectrum of that anion approaches the ultra-violet. The common light waves and heat waves are in their action like those of the positively charged ion.

It may be remarked that so far as the alleged discovery relates to electricity it rests upon a rather slender foundation. The ionic theory is so far from being established that it may be considered not much more than a working hypothesis, and the Chicago professors appear even to have taken unwarranted liberties with the hypothesis in their assumption as to charges rotating about atoms at different rates, of "one-charged" and multiple charged ions, and, in general, in assuming the existence of a definite ionic mechanism. Dr. H. P. Pratt, the X-ray expert, confirms the discovery, however, but claims that he also had been working along the same lines. Dr. Pratt further believes that the twentieth century will prove that electricity and not sodium is the real life-giving principle.

Electrical Engineers of the Day—XXVII.

FRANK P. COX.

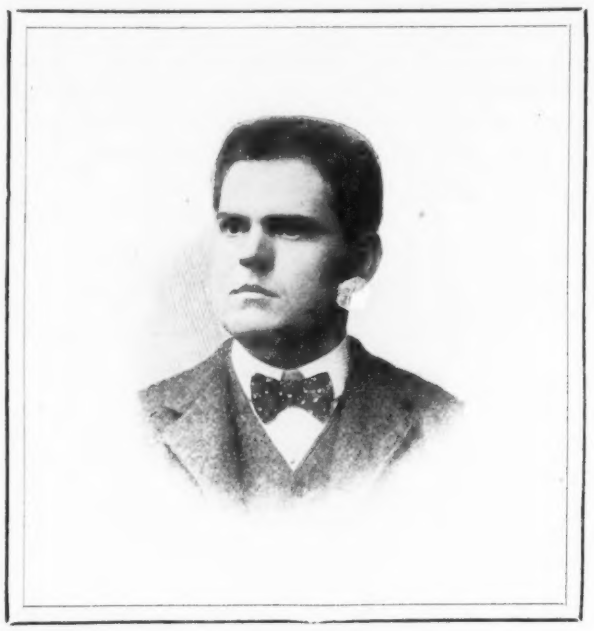
Frank P. Cox was born Dec. 31, 1866, at Terre Haute, Ind. After completing the curriculum in the common schools of his native city he took a two years' preparatory course and entered the Rose Polytechnic Institute, whence he was graduated as a mechanical engineer in 1887. A post-graduate course in electrical subjects was afterward taken at Johns Hopkins University, of Baltimore, and in the latter part of 1888 Mr. Cox entered the employ of the Kester Electric Company in his native city. He remained there about one year, during which time he was engaged in the design and manufacture of small motors.

In October, 1889, Mr. Cox entered the testing department of the Thomson Electric Welding Company, where he remained until June, 1890. About this time the Thomson recording wattmeter, which heretofore had enjoyed only a rather limited sale, begun to be fully appreciated by central station managers, and orders commenced to flow in for them at a rapid rate. About 1000 had been built at this period, and the weekly production was from 50 to 75.

With the advent of increased business, the Thomson-Houston Company found it necessary to extend its facilities materially, and reorganized its meter manufacturing department. In July, 1890, Mr. Cox was employed to take charge of the meter-testing department of the Thomson-Houston Company. He continued to have charge of this department until the formation of the General Electric Company, and until 1894, when the business had grown to such an extent that another re-organization was necessitated on much broader lines. As a result of changes then made, Mr. Cox was appointed engineer of the meter department, and assumed, in a great measure, responsibility for the mechanical as well as for the electrical and magnetic features.

A few years later the manufacture of instruments was begun by the General Electric Company, and a large portion of the engineering work in connection with this was placed in Mr. Cox's hands. Mr. Cox has surrounded himself with a corps of efficient assistants, nearly all of whom have had their practical education under his training, and at the present time the details of the engineering work are largely in the hands of these assistants, thereby leaving Mr. Cox free to take a more active part in commercial engineering than he has heretofore been able to do. His position is a rather unique one, as such positions go, in that he has largely made it for himself and to suit himself.

Aside from the general factory supervision over the designing, manufacturing and testing of motors and instruments, Mr. Cox devotes a large amount of time in a semi-commercial and advisory capacity, in connection with the installation of large instrument and meter groups in central power and lighting stations.



Although Mr. Cox has contributed a few articles to the technical journals, and written one book on direct-current dynamos and motors, he has found little time in the press of his routine duties, to contribute much of that which he is so well qualified to write upon to the use of electrical readers. He has been obliged to undertake many extensive studies in the solution of intricate problems which have confronted the General Electric Company's engineers in the design and improvement of instruments and meters, one of the most notable being the investigation of the manufacture of permanent magnets on a commercial scale.

One of the fundamental necessities of the manufacture of the Thomson recording wattmeter is the maintenance of permanent and uniform damping magnets. To accomplish a means of attaining this end on a commercial scale required a vast amount of research, study and experimentation, all of which was successfully done, as is evidenced by nearly 500,000 meters now in use. Mr. Cox has been allowed a number of patents relating to various phases of meter and instrument design, and has introduced a great many methods of manufacture and manipulation, which, for obvious reasons, are unpatented.

Mr. Cox is married, has one daughter, and lives in Lynn, Mass. Although of a rather retiring disposition, Mr. Cox has a very wide circle of friends and acquaintances.

The Waterside Station of the New York Edison Company—I.

INTRODUCTION

FIG. 1.—DOORWAY, WATERSIDE STATION.

THE happy lot falls to us about once in every five years to chronicle the development and growth in the intervening period of the New York Edison Company—the greatest central station organization and enterprise in the world. Many of our readers will doubtless recall the comprehensive survey made in one of the constituent journals of ELECTRICAL WORLD AND ENGINEER, in 1896, and previous to that period our columns preserve the record of the technical and industrial advance which now finds its furthest present reach in the magnificent Waterside station to which this article will be more specifically devoted. It is a theme to which we return with more than usual pleasure, and from whose consideration more than ordinary instruction results. Around the career of the New York Edison Company cluster historical events, pioneer beginnings, daring experiments, personal anecdotes, continuous successes, technical evolutions, financial expansions and steady broadening of relationships of the most interesting character, full justice to which would demand not merely the occupation of a few score pages of this journal, but the compilation of a volume. We have in the growth of this great enterprise a review, not in miniature, but on the grand scale, of what the art of electric light and power has attempted and realized in America.

It is not intended in these introductory remarks to summarize the details treated in each of the sections of this article, but so important a theme is not without its opportunities for a more or less philosophical treatment. There is not much chance or need for "academic" discussion in the stern and sober record of the remarkable onward movement of this company, which grapples so closely with the necessities of a great modern city in matters of illumination, power and multitudinous conveniences, but it cannot be forgotten that the history of this company illustrates in itself at once the relation of electricity to modern life and all the other tendencies that are so profoundly influencing our civilization. Here is a system beginning with but one class of work, and within a very limited area, but now furnishing current for every purpose to which it acn be applied, and covering the whole of Manhattan Island. Here is a system founded when the storage battery was a byword and the alternating current a dubious thing of deep suspicion, now using more batteries than any other plant in the world as reservoirs and equipping for alternating current generation the largest station that has ever been seen. Yet, on the other hand, as evidence of the persistence of methods that hav approved themselves are still to be noted the practice of putting every wire underground, just as in the start nearly a quarter of a century ago, and, further, the steady maintenance at the consumption end of the system of direct-current methods, with low voltages. Such conditions in dealing with some of the most vital problems that can confront an electrical engineer imply, to say the least, great courage on the part of those who have had to deal with these questions and a capacity of intellectual grasp, which in turn promise a firm touch with all that the future can bring in the art. Last year, at the meeting and Congress in Paris, as this year before one of the most crowded gatherings the American Institute of Electrical Engineers has ever held, these very problems of transmission, distribution and utilization were the most pressing that could excite the interest of such bodies; but even while the discussions were going on, the New York Edison Company, with its fellows in the field of central station work, was attacking the problems and solving them, even if not with final wisdom, at least with the satisfaction of marking genuine progress. It is one thing to play the game of war with mathematical theories and dummy squadrons, and quite another to present the brave front and adopt the shrewd tactics that ensure victory in a hard-fought campaign. "Settle it as you go," is an ancient bit of advice, but surely its most modern application lies in central station work, where every question solved with pains to-night opens up a broader problem for swift determination on the morrow.

Running side by side with this insistent requirement for high engineering ability in dealing with these matters, and not simply incidental to it, has been the financial problem. The original central station idea was that of several main generating plants in any given city, each jealous of its own territory, but often limited sharply in its kind of service, and rarely able to give that service cheaply or

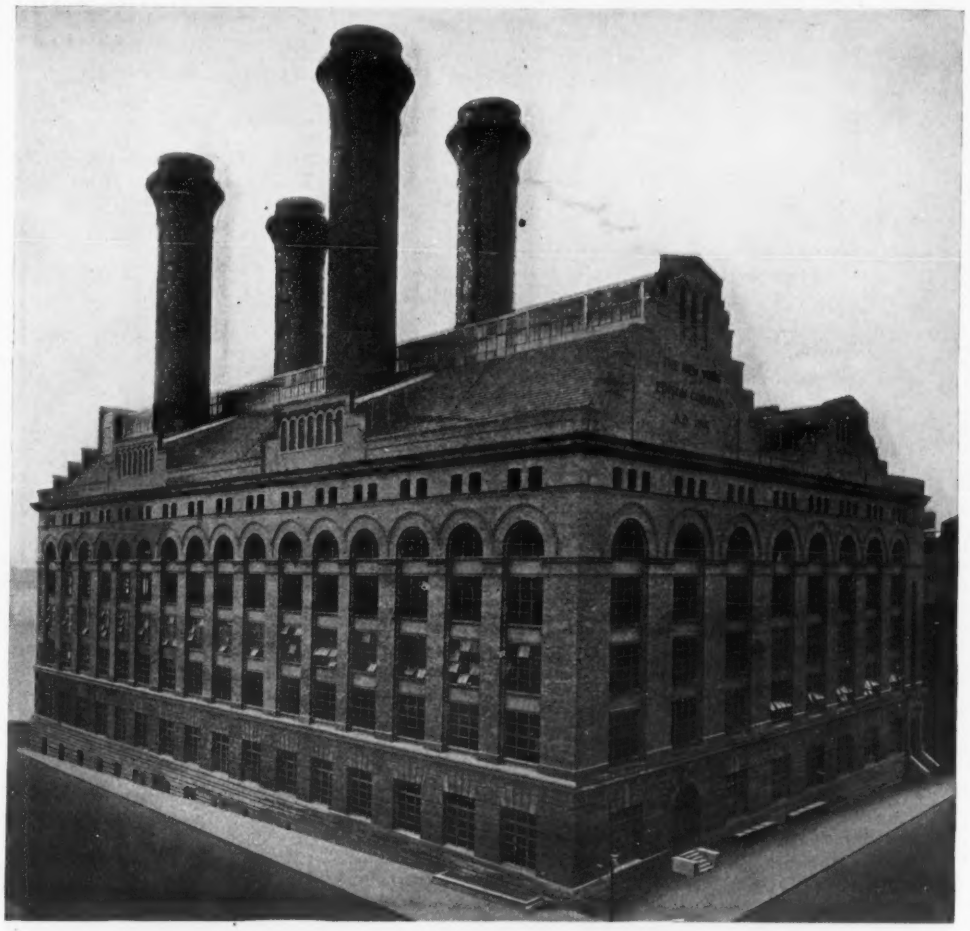


FIG. 2.—VIEW OF THE WATERSIDE STATION, SHOWING BOILER ROOM FRONT AND WEST FRONT.

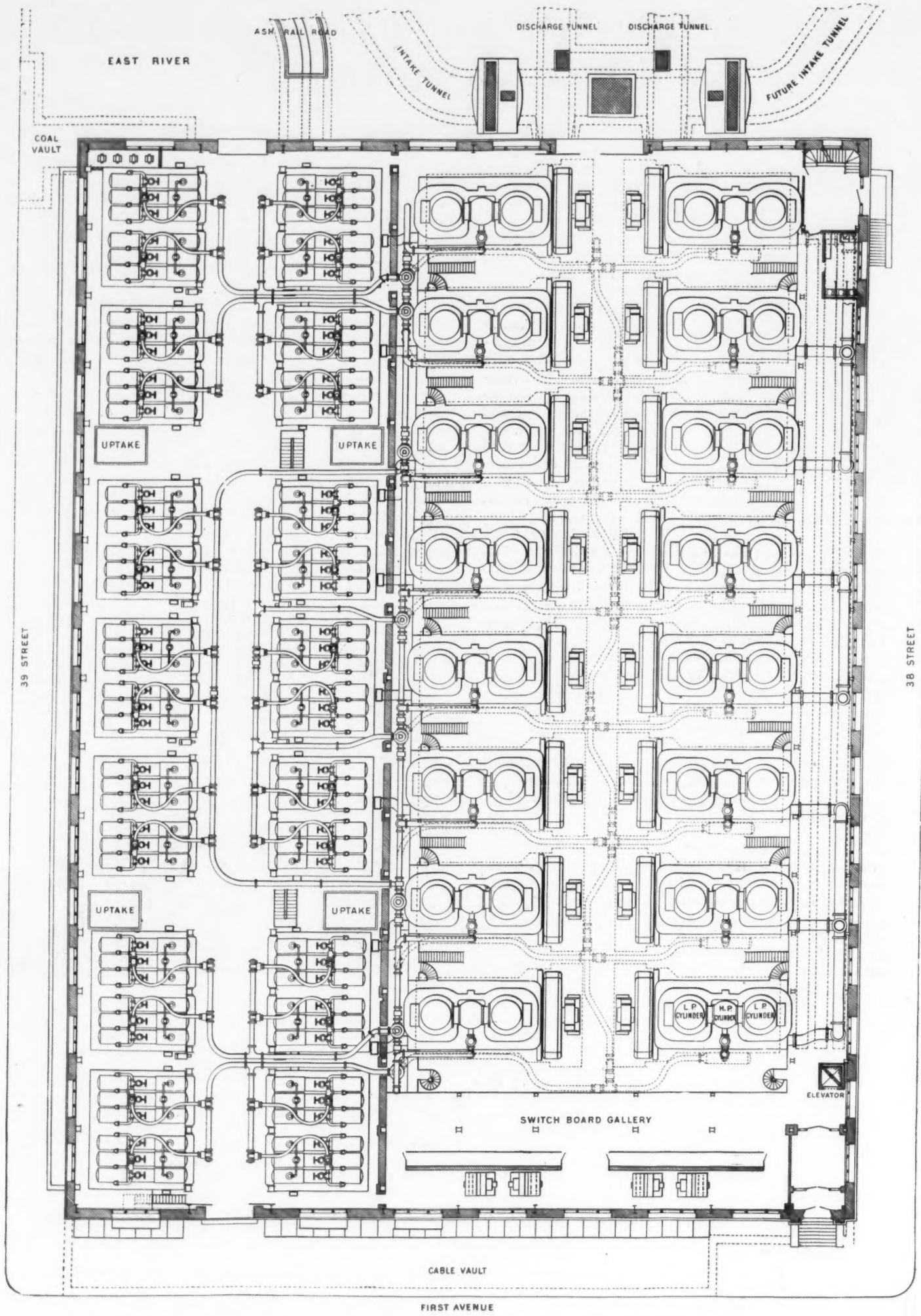


FIG. 3.—PLAN OF THE WATERSIDE STATION OF THE NEW YORK EDISON COMPANY.

efficiently. But that day has gone by, and with the development which has aimed at the generation of one universal type of current for use by apparatus of the widest individualization has had to come necessarily the welding together financially of the different interests concerned in the work. The tendency towards consolidation of productive and distributive agencies of all kinds is too much a commonplace nowadays to need noting with any emphasis here, but we cannot neglect the chance to express our belief that electric light, power and traction have afforded some of the best examples of the carrying out of this line of industrial evolution. Possibly, and doubtless, mistakes have been made in the execution of this inevitable process, but our conviction is deep that in the long run the programme will have justified itself in most cities and with most people. In the New York Edison Company, with the marvelous network of service that has been gathered together under that name, the conspicuous exponent of this policy has been Mr. A. N. Brady, whose striking appreciation of the broad principles involved in electrical application has been admirably evidenced by some of his recent utterances in leading organs of public opinion. For a man popularly credited with merely the "Wall Street view" of these topics, Mr. Brady has shown an insight and foresight that perhaps some did not expect. So far as we are concerned, dealing, as we do less with the financial aspects of the art than with its engineering side, we can only express our hearty admiration of the faith in electricity shown by such a boldness and vigor of financial enterprise as leads to the erection and equipment of plants like the Waterside station described below—enterprise based in turn upon the massing into one vast, comprehensive network of all the scattered, heterogeneous and unrelated projected which not long since were all that New York had to depend upon for its electric light and power. The greatest credit is, therefore, due to Mr. Brady for having early recognized the stupendous possibilities of such a situation, and for the courage and broad statesmanship which he has shown in bringing such a vast undertaking to a successful consummation. In like manner, this passing personal reference would not be complete without mention of the work of Mr. Thomas E. Murray, whose natural ability, tireless energy and sound engineering judgment have contributed so largely to the satisfactory carrying out on the practical side of this vast plan of consolidation and concentration.

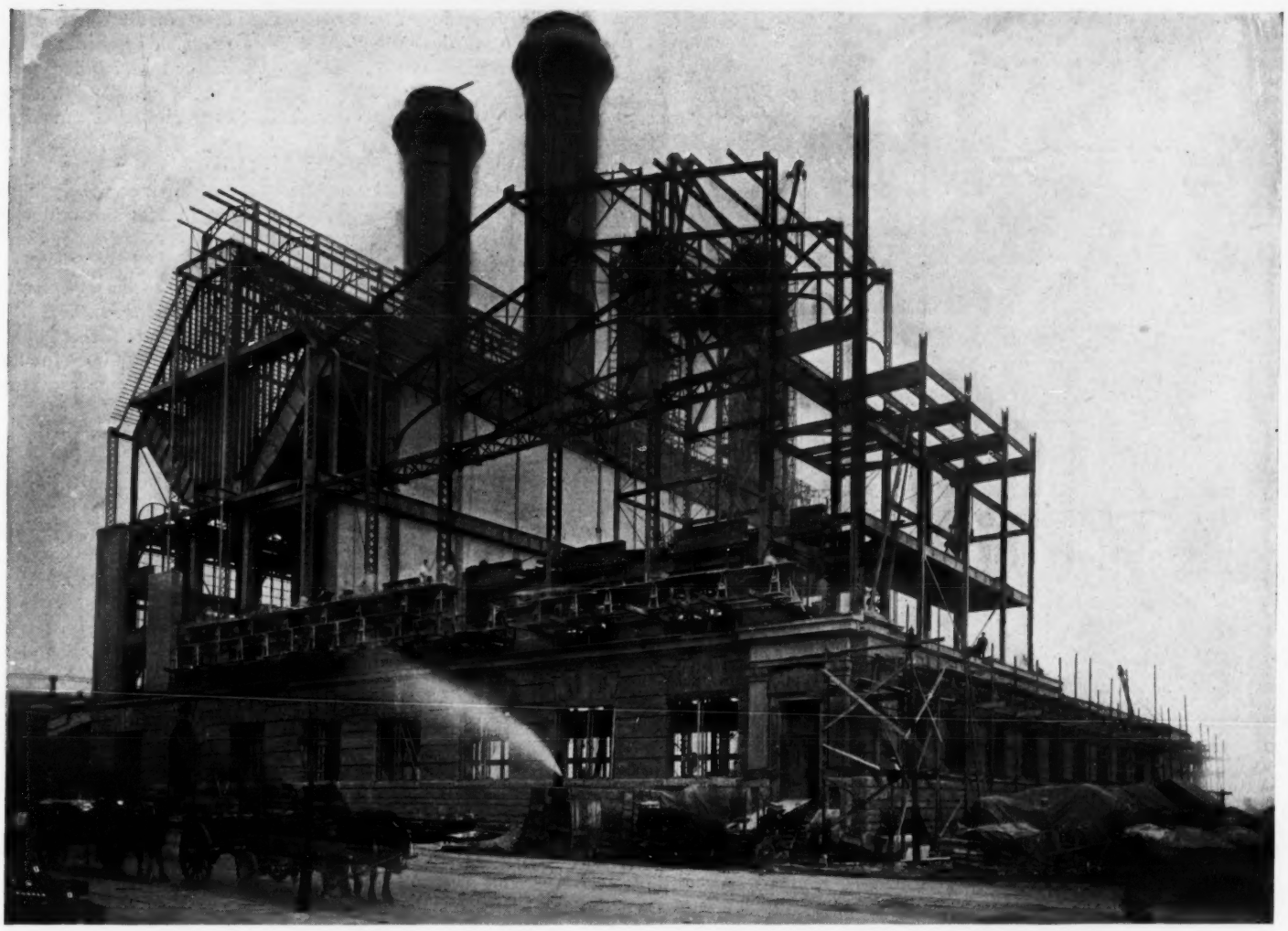


FIG. 4.—WATERSIDE STATION UNDER CONSTRUCTION, SHOWING STEEL FRAMEWORK.

THE PROBLEM OF CURRENT AND DISTRIBUTION.

The problem of furnishing light and power to a large city like New York involves the supplying of the densely populated business and southern district, and also requires that current be transmitted to a large outlying residence district covering many square miles in area and in the case of New York extending north 10 miles from the heart of the city.

Numerous small stations distributed through this territory furnish a possible solution of the problem, but such a system lacks the well-known advantages and economy of a large central station. It being impossible to supply such an area with direct current from a single station it was decided to use a high-potential, alternating system of generation and transmission.

The question next arose, Shall the customer be supplied with alternating or direct current? It would be much simpler to supply alternating current through step-down transformers, but the question can only be answered by a consideration of the service required.

This is the supply of power for incandescent lights, arc lights and motors—the latter both for general power and elevator service.

Incandescent lights operate equally well upon direct or alternating current, provided the frequency is over 30 cycles per second. They require, however, a close voltage regulation, and where heavy currents are to be handled, as in the business district of a large city, this can be better secured by direct than by alternating current.

The arc lamp may be used upon direct or alternating circuits provided the frequency is not less than 40-50 cycles, and although the New York Edison Company has found that satisfactory commercial service can be obtained from alternating current arcs on

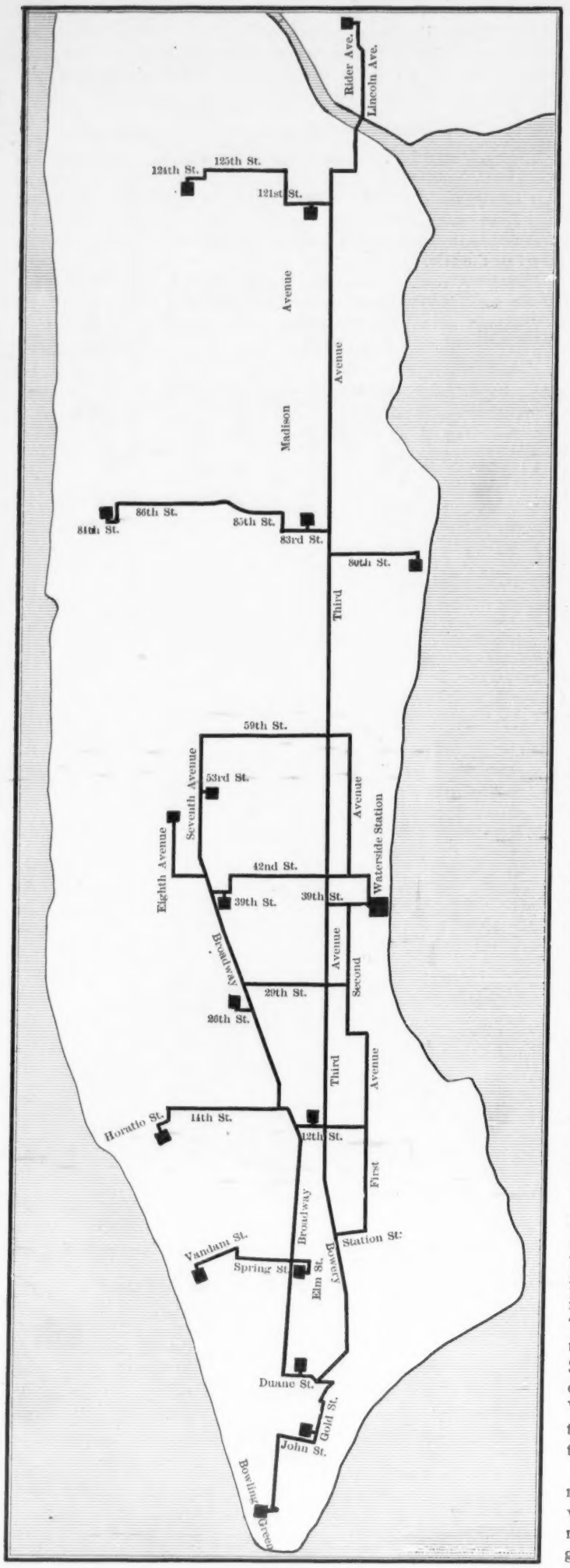


FIG. 5.—NEW YORK EDISON WATERSIDE, SUB-STATIONS AND HIGH-TENSION MAINS.

ordinary circuits, direct-current lamps are, considered on the whole, somewhat more efficient and reliable.

For general industrial use, the alternating-current motor, particularly that of the induction type, has reached a stage of perfection making it in every way the peer of the direct-current motor, the absence of commutator and brushes constituting a prime element of simplicity and ready maintenance, although involving a higher first cost.

Though constant speed motors may be designed to operate with satisfaction on alternating currents, yet the direct current motor is decidedly superior where intermittent service or variable speed is required. As a considerable part of the power used in large cities is required for elevators, and machinery running at variable speed, it becomes almost obligatory to furnish direct current to satisfy this demand.

After a careful consideration, therefore, of all the local conditions—the character of the large existing stations, sub-stations and underground system, the territory to be covered, the present and prospective business, the broadening nature of the electrical industry, and other features none the less perplexing, because less indefinite in engineering outline—it was decided to build a large central station generating high potential alternating current, transmission to sub-stations, and after passing through static transformers and rotary converters to be fed as direct current into the usual low-tension, three-wire network.

In deciding upon the location of such a central station the general rule that it shall be located as nearly as possible at the center of gravity of the system is often modified by the cost of land, availability of water supply, coaling facilities and various local considerations. The Waterside station of the New York Edison Company is admirably situated to satisfy all these requirements.

When we look back to 1882 and compare the Pearl Street station of the New York Edison Company and its six 125-hp "Jumbo" generators, with the new Waterside station of the same company, operating sixteen 5500-8000-hp generators, we are enabled to form some conception of the enormous growth of the business in the 19 years just past.

Between these two extremes we have the Duane Street station, erected in 1891, with the system of sub-stations, by which the city of New York has been supplied.

This station was erected before the era of high potential transmission in cities, and perforce was located near the "center of gravity" of the load. Real estate in the heart of the business center of New York City being very expensive, it was necessary to concentrate the power in the smallest space. This result was attained by the adoption of the vertical marine type of engine, which was modified to meet central station requirements by the company's engineering staff, cooperating with the engine builders.

The 2500-hp engines used in this station were the first vertical marine engines of any considerable size used in this country for central station work.

The form of switchboard, first installed in this station, and now in use there, and in the other sub-stations throughout the city, is remarkable for its space economy, and was also developed by the company's technical staff. In the Van Vleck "edgewise" system all instruments and regulating switches are read or handled on the edge of a quarter circle, instead of being moved around the face.

Owing to the fact that in New York and other large cities the heaviest load in the business section occurs at a different time from the peak load in the theater and residence section, it would evidently be a most desirable and economical arrangement to have the stations in these districts so connected that each could help the other, utilizing the capacity of the generating equipment to the best advantage. This result was attained before the completion of the Waterside station by installing rotary converters and static transformers in Duane Street and the various sub-stations. A net efficiency of over 82 per cent from direct current to direct current is obtained, and now that Waterside station is in operation the apparatus already installed in the sub-stations is used to transform from high-tension alternating to low-tension direct.

It became evident several years ago that even with this system of mutual help the time was soon coming when the full capacity of the various stations would be inadequate to supply the demands of a rapidly increasing number of consumers; and the multiplication of generating stations being undesirable, plans were drawn for a new station where practically all the current used by the company could be generated, the various stations throughout the city being retained as rotary converter sub-stations.

The Waterside station, equipped with the most modern and economical plant, will generate the bulk of the current used on the system, the larger Edison stations, Duane, Twelfth and Twenty-sixth streets, being used as distributing stations, and as supplementary generating stations during the period of heavy load in the winter months.

Some of the less important stations, Vandam, Thirty-ninth and Fifty-third streets, equipped with less economical generating apparatus, will have their generating equipment removed and will serve as distributing centers. Storage batteries located at all the important distributing centers, in addition to acting as a reserve, will also be used to eliminate the peaks from the local demand, so that the load on the Waterside station will be almost constant during the twenty-four hours. By utilizing the more important generating plants during the months of heavy demand, the larger generating apparatus already installed is used to advantage, additional new investment being saved, which would otherwise be necessary to take care of this capacity.

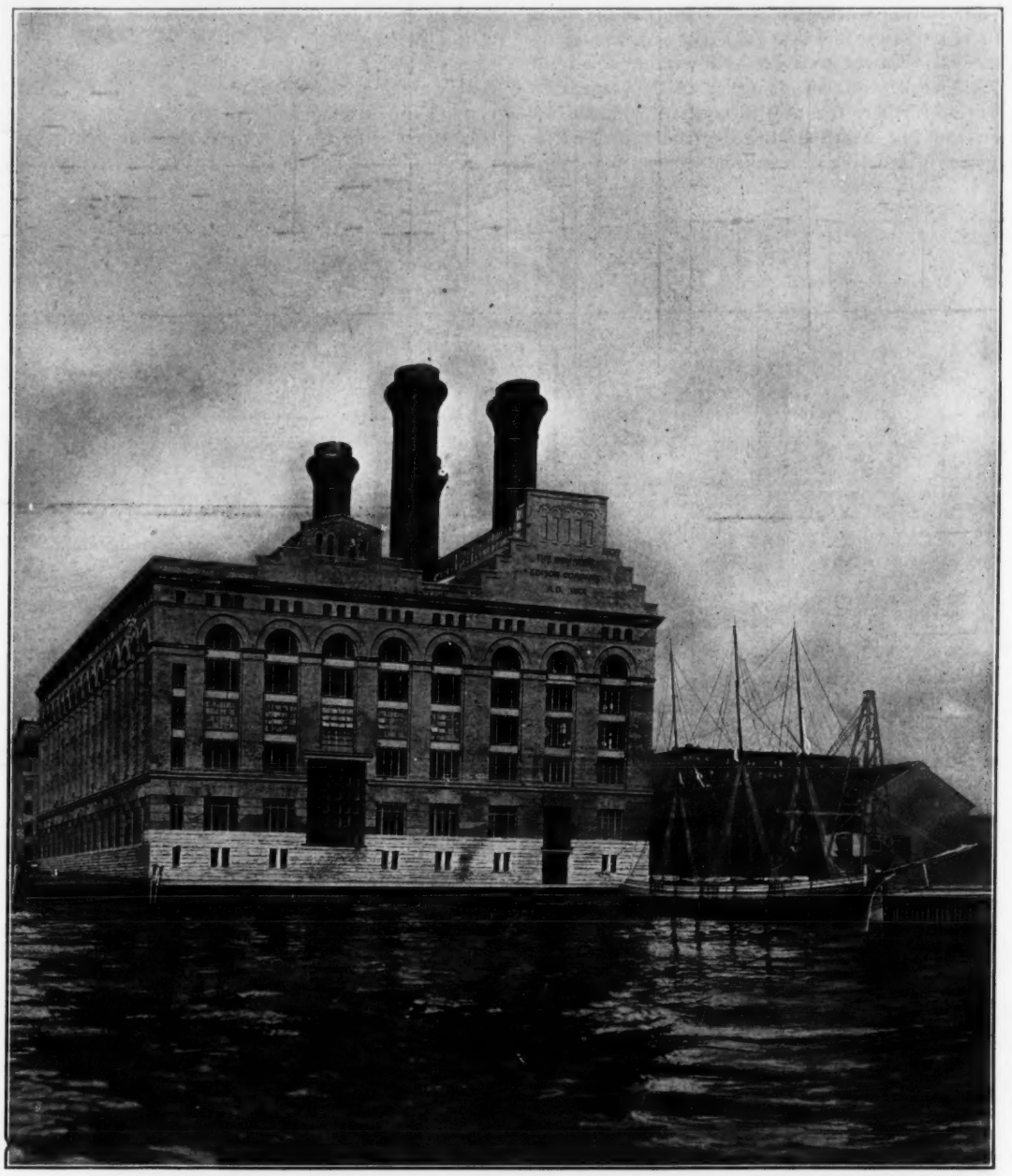


FIG. 6.—WATERSIDE STATION OF THE NEW YORK EDISON COMPANY, FROM THE EAST RIVER.

THE BUILDING.

The Waterside station is located on First Avenue, covering the block between Thirty-eighth and Thirty-ninth streets, and running to the East River, an area of 272½ ft. by 197½ ft.

The bulkhead line will be 160 ft. distant from the east end of the station, and separated from it by a new marginal street 125 ft. wide, under which pass the condensing tunnels and coal conveyors. It is not until one sees a colossal operation of this kind that the extent to which the city is gaining territory along its eastern water front is realized. Such plants as the Waterside help in no small measure to what may be called the reclamation of this valuable waste territory.

The foundations for both engine and building are of concrete and rest directly upon bed rock, giving an exceptionally solid construction.

The building is of yellow brick, trimmed with red sandstone. The inside of the operating room is faced with pressed buff brick, with the exception of a wainscot of enamel faced brick, 14 ft. high, running around the entire room. The floor is of cast iron plates, and the roof, 116 ft. above, has a glass monitor giving abundant light.

The boiler room floor, with the exception of the cast iron plates along the boiler fronts, is of granolithic material.

The general layout of the building is shown in Fig. 3. The boiler room, a magnificent hall, is 76 ft. by 267 ft. 10 inches, separated by a massive brick wall from the main operating room, which is of the same length and no less than 115 ft. wide, presenting in its lofty pitch and harmonious porportions a strong resemblance to the main aisle of some grand and imposing cathedral.

The 16 General Electric dynamo-Westinghouse engine generating sets, included in the complete plan, as shown on the diagram, are placed each on its separate foundation, and each with its immediate and switching appurtenances constitutes a "cellular" unit, as though it alone were the generating heart of the station. The features of this interesting and important arrangement will be discussed later. The dynamos all face inward to the central passageway, their right and left-handed revolution corresponding to their

position on the north or south side. The storage battery room is in the basement on the Thirty-eighth Street side, south, as indicated. Locker rooms, lavatories, etc., are provided in liberal measure for the comfort of the employes. On the Thirty-eighth Street side, running the full length of the stately building, there are five galleries, the upper ones being used for storage, offices, etc., while the two lower ones afford ready access to the upper platforms of the engines. It is impossible not to be struck with the skillful manner in which the designers of this great station with its ultimate capacity of not less than 125,000 hp have pushed along practical lines, in these details, the analogy with marine engineering which underlies the ideal of modern central station work. A mere glance at the cross section view shows these galleries, just like the decks of a big steamship, surrounding the vast central well or hull within which the steam forces are at their work, while an inspection of the plant itself carries the parallel even further, for at the western end are the switchboard galleries, the full width of the dynamo room, corresponding in by no means a fanciful manner to the "quarter deck," whence command issues and through which all the functions of the system are set in motion and exercised.

This western end is, as will have been understood, the front of the building, where is found the handsome entrance from which our initial letter has been drawn. An electric elevator, built by the Marine Engine & Machine Company, and located just within the entrance lobby, gives quick access to all floors, supplementing the metal stairways which rise at both ends of the electrical galleries. The steel framework of the building was furnished by Milliken Brothers. Two electric cranes, one of 50 tons capacity, built by Pawling & Harnischfeger, of Milwaukee, and one of 25 tons, built by Alfred Box, of Philadelphia, span the engine room at the curve of the roof. The former has a high speed lift auxiliary hoist which enables the quick handling of light weights over the whole floor.

COAL-HANDLING EQUIPMENT.

Going now from the front of the station to the rear, we encounter, and begin naturally with, the coal-handling equipment. The coal will be received at the pier being built out into the river, 150 ft. beyond the bulkhead line. On this pier will be located the coal-receiving tower. It carries a bucket with a capacity of 1½ tons, which discharges into the hopper from which the coal descends into the crusher, passing thence into the bucket conveyor running along the pier and under the marginal street into a receiving vault at the northeast corner of the building. Here the coal is received into the weighing hoppers, and is then discharged by the automatic fillers into the vertical conveyors which elevate the coal to the monitor, where a horizontal conveyor finally distributes it into the bunker. This, as shown in the sectional view, is of solid steel construction, and has a capacity of 10,000 tons, sufficient for two weeks' supply. Coal chutes descend from the bunker, each chute feeding the stoker hoppers of two boilers, and each is equipped with a Clarke automatic coal weighing scale. The bunker is lined with concrete, no coal coming into contact with the iron, and a deflecting ridge along the bottom prevents the lodging of coal in dead pockets where it might take fire from spontaneous combustion. The entire coal-handling

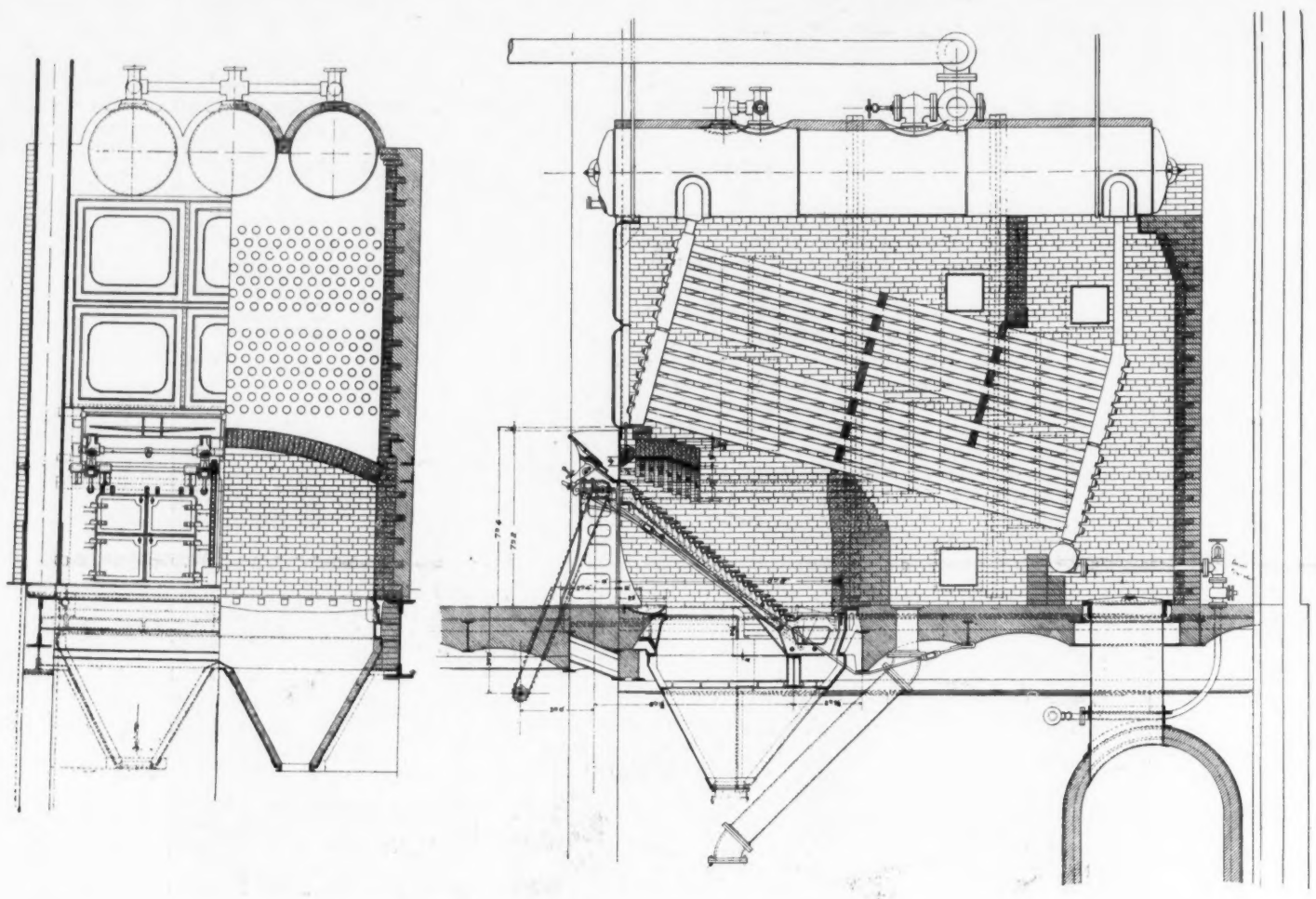


FIG. 7.—ELEVATION AND CROSS SECTION OF BOILERS AND STOKERS.

equipment was supplied under contract by the Exeter Machine Company.

THE BOILERS.

The boilers, whose construction and location are shown in Figs. 3, 7 and 11 were made by the Aultman & Taylor Manufacturing Company, of Mansfield, Ohio. They are arranged in two double-decked rows, one on each side of the boiler room, 14 in each row, 28 on a side, or 56 in all. They are each 18 ft. long, with 6250 sq. ft. of heating surface, and are rated at 650 hp each, on a 30-lb. basis; but as the engines used will require only about 12 lbs. of steam per I.H.P., the boilers will actually develop about 1625 hp each. When operated with forced draught, they can develop a much greater capacity.

The boilers are designed for a working pressure of 225 lbs., although 175 lbs. will be the pressure usually carried. They are equipped with Roney stokers and furnaces supplied by Westinghouse, Church, Kerr & Co. Sixteen fan blowers of large capacity will furnish the forced draught, so that the maximum capacity may be ob-

tained from the boilers, enabling also the use of steam sizes of anthracite coal in connection with the Roney stokers. It should be added that the Roney stokers have the greatest possible depth of

FIG. 8.—DETAILS OF BOILER ROOM WALL CONSTRUCTION.

grate in the available space to give the greatest feasible grate area, in view of the desirability of burning anthracite coal. It must be mentioned here also that provision has been made for the installation of superheaters on the boilers, proper fittings having been provided for connecting them, as the engines have been designed with an eye to the ultimate use of superheated steam.

Returning to the stokers, they in common with most of the other "auxiliaries" are driven by steam, these being operated in sections by sixteen 5-hp Westinghouse engines, and connected to the driving shafts in such a manner that the breakdown of any engine will not cripple any stoker. The furnaces discharge the products of combustion into four steel stacks, each 17 ft. in diameter, and rising 132 ft. above the roof, the tops being seen in our engravings and being plainly visible from a great distance along the river; the total height from the grates of the lower tier of boilers being very nearly 200 ft. The shell of the stacks is ⅝ inch thick for 44 ft., other sections of the same length being made up of ½ and ⅜-inch plate. The stacks are lined with 8 inches of firebrick for one-third of their height, the remainder being lined with red brick. The lining is carried upon rings of angle iron in independent sections of 20 ft., and air space of 4 inches being left between the lining and the stack. The ashes are discharged from the ash hoppers under the boilers into cars, which are to be hauled with small electric locomotives to the dock and the contents dumped into barges. Space has been provided in the basement for economizers in case it may be deemed desirable to install these before the completion of the station.

STEAM PIPING AND HEATERS.

The steam is delivered from each boiler through a 10-inch pipe into a 14-inch boiler room header, of which eight enter the engine room through openings in the fire wall from each deck of boilers, as indicated in various views herewith. The headers from the upper deck drop into steam separators connected in the main engine room header, from which steam pipes are taken to the northerly row of engines. Vertical risers drop from the engine room header and receive the steam supply from the headers of the lower tier of boilers, conveying the steam to separators in the basement, from which 14-inch mains carry it thence to the throttles of the southerly line of engines. Special fittings are connected to the cross-over pipe to each southerly engine, permitting their connection into a central tie header located under the center aisle. All joints are ground to a steam-tight fit, no gaskets being allowed in any of the high-pressure piping. The pipe, special fittings and flanges are of the maximum thickness specified for the highest class of high-pressure work. The feed water heaters are of the Wainwright type, 50-inch diam., 16 ft. long, containing 246 1½-inch tubes, giving a total heating surface in each heater of 1333 sq. ft. These heaters are inserted between the feed pumps and boilers, and receive the exhaust steam from the boiler feed pumps, stoker engines, and other auxiliaries. The feed water will be supplied for the city service in the beginning, although it is expected later to use the condensed steam from the engines as boiler feed after being purified. To this end four special storage and separating tanks have been installed in the basement under the boilers, provision being made in each tank for cartridge filters for removing the greater quantity of oil from the condensed steam. The more complete elimination of suspended oil to be affected in special purifying apparatus. The boiler feed pumps are of the Worthington type, steam driven.

CONDENSING WATER TUNNELS.

The condensing water is brought from the river through an intake tunnel, shown in Fig. 9, built by the General Tunnel Engineering Company, under the Landé patents. This interesting intake tunnel is composed of two ¼-inch steel shells, with a space of

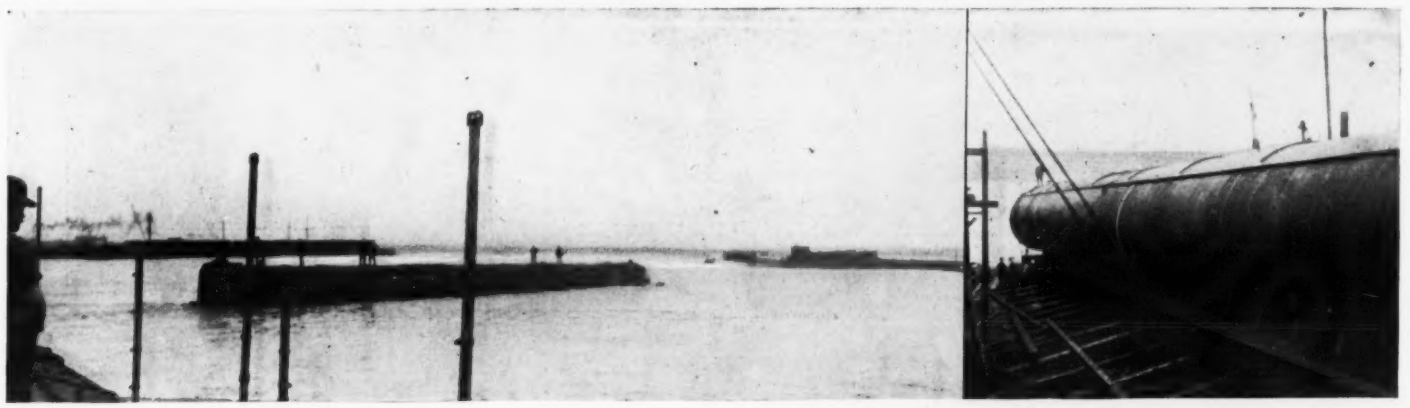


FIG. 9.—CONDENSER TUNNEL AT ELIZABETHPORT, AND ON ITS WAY TO THE STATION.

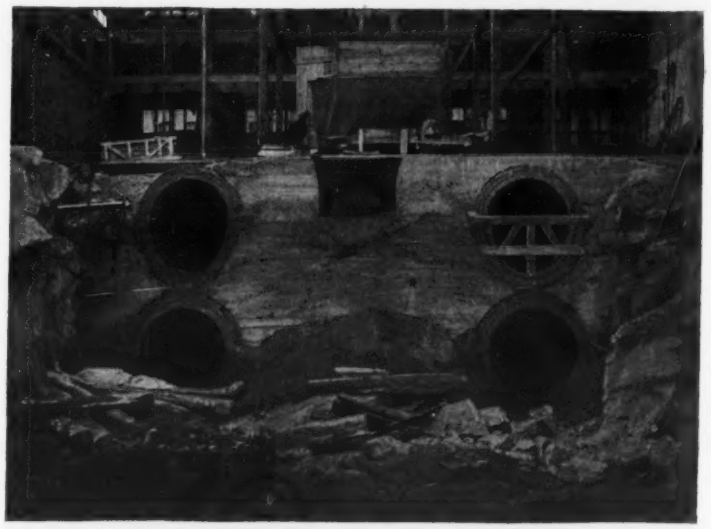


FIG. 10.—DETAILS OF FOUNDATION, CONDENSER TUNNELS AND CABLE GALLERY UNDER ENGINE ROOM.

15 inches between them filled with concrete. It was made in Elizabethport, and when finished was fitted with bow and stern and towed

to its present position. It extends from the east end of the station 230 ft. diagonally under the proposed marginal street along the river front out into the East River. Provision is made for connecting another similar tunnel, should it ever become necessary. Just outside the building the intake tunnel enters the screen wells and divides into two parts, circular in section and 7 ft. in diameter, one running under each row of engines. The discharge water from the condenser is returned to the river through two tunnels of an oval section 8 ft. high, running out on a higher level.

THE ENGINES.

The engines, 16 in number, are the product of the Westinghouse Machine Company. They are of the Marine type, vertical, three crank, with one high and two low-pressure cylinders, direct connected to 16 General Electric three-phase generators. The high pressure cylinder is 43½ inches in diameter, and each low-pressure cylinder 75½ inches in diameter, with a stroke of 5 ft. The low-pressure cylinders only are jacketed, and are provided with liners, the contemplated use of superheated steam rendering jackets for the high pressure cylinder unnecessary. With 175 lbs. steam pressure at the throttle and 27 inches vacuum, and while running at the normal speed of 75 r. p. m., the engines are to indicate 5200-5500 hp at most economical load; and will be capable of a sustained load of 8000 hp with an ultimate capacity at maximum cut-off (⅝ of stroke) of over 10,000 hp. The engine is guaranteed to develop its most economical load, 5200-5500 hp, at a steam consumption not to exceed 12½ lbs. of dry steam per I.H.P. per hour, including the steam used in reheater and jackets.

The bed plate is made in three pieces with an extension for supporting the outboard bearing. The engine frames are of the A type of strong and massive yet graceful design, with a substantial bearing on the bed plate. The crank shaft is of the Bethlehem make, built up in three sections, with a 10-inch hole extending from end to end. The 26-inch shaft is supported in four bearings, the three main bearings each 60 inches long and the outbound bearing 48 inches long. The engine, having three cranks, set at the angles 101 degs., 133 degs., 126 degs., so as to give a uniform turning moment, does not require a heavy flywheel, a weight of 90,000 lbs. in the rim with an outside diameter of 23 ft. being sufficient to give the required steadiness of motion for parallel operating and avoiding any evidence of "beat" or pulsation in the electrical system.

The high-pressure cylinder is fitted with poppet valves, following European practice on engines of similar types using superheated steam. The low-pressure cylinders have valves of the double ported Corliss type. The valves are driven by eccentrics from a lay shaft receiving motion from the main engine shaft by means of helical gears, European practice again being followed in this respect also, although quite unfamiliar here. The governor is driven from the lay shaft and controls both the high and low-pressure valves, the latter being also detachable so as to be adjusted by hand.

The engine speed can be controlled by mechanical adjustment of the governor weights while in motion. To facilitate synchronizing the speed of the engine can also be varied from the electrical gallery by a pilot switch operating an electrical motor which shifts the weight on the governor arm.

An emergency steam-operated throttle is provided enabling steam to be shut off instantly, and this is connected to a centrifugal device in one of the crank cheeks, which in case the engine speed exceeds a certain limit engages a pawl admitting steam to the emergency throttle automatically, and cutting off steam. In passing from the high-pressure to the low-pressure cylinder the steam passes through the reheater with a capacity of 220 cubic feet.

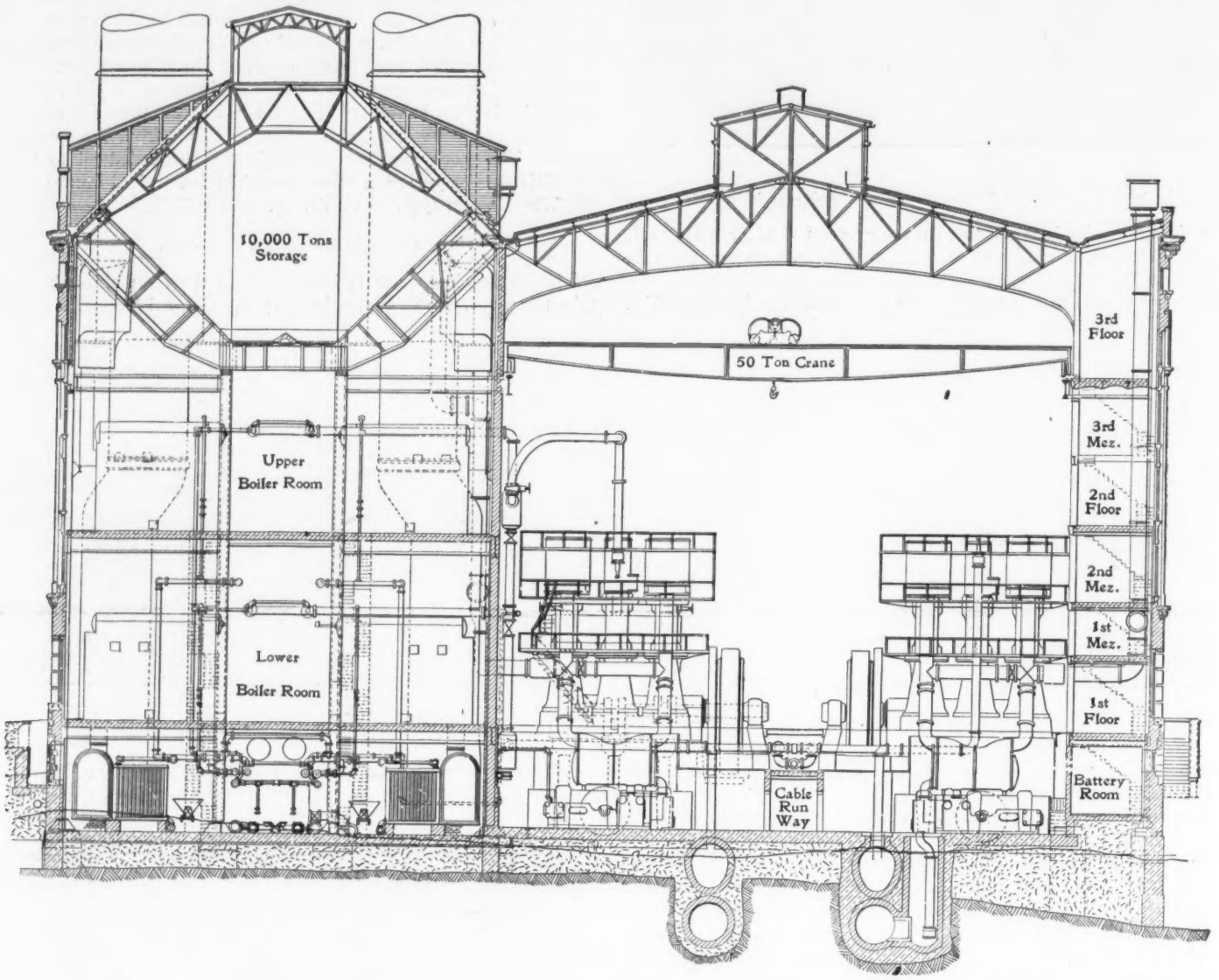


FIG. 11.—CROSS SECTION THROUGH BOILER AND DYNAMO ROOM OF WATERSIDE, NEW YORK EDISON, STATION.

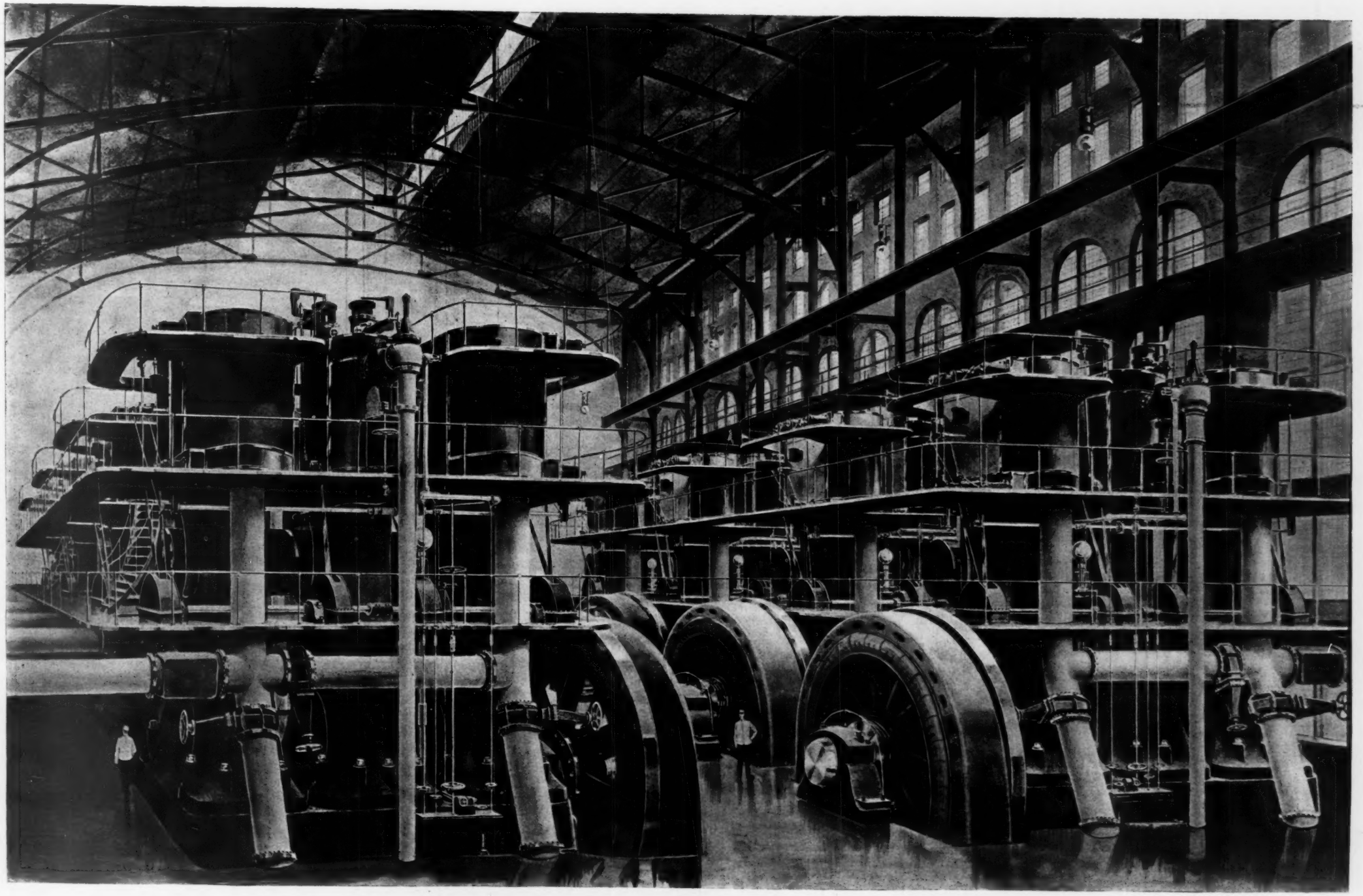


FIG. 12.—VISTA OF THE DYNAMO AND ENGINE ROOM, SHOWING ABOUT ONE-HALF, AS SEEN FROM SWITCHBOARD GALLERIES.
THE WATERSIDE STATION OF THE NEW YORK EDISON COMPANY.

A complete oiling system is provided, the main bearings being fed with a gravity-pressure system, and the cylinders, cross-heads, etc., are lubricated from sight feed manifolds having pressure pumps driven from the valve motion. The oil is circulated by a special

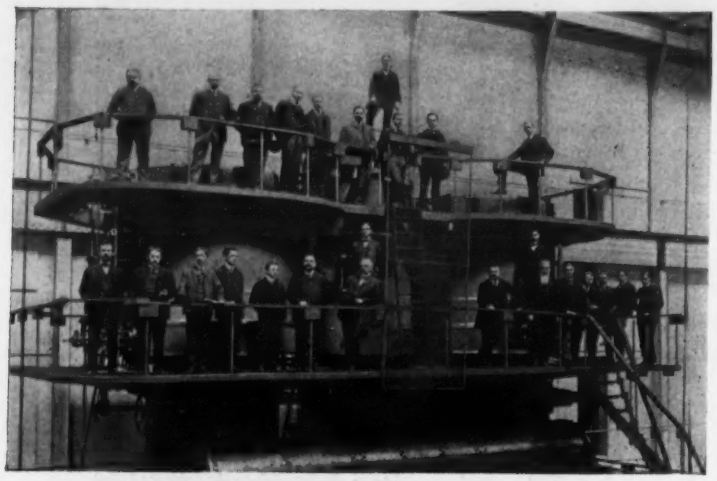


FIG. 13.—THE TWO UPPER PLATFORMS OF ONE OF THE ENGINES.

force pump, with a system of tanks for its filtration. Each engine has an independent air and circulating pump driven by a separate engine with Corliss valve gear. The surface condensers are of the Worthington type, with a cooling surface of 9200 sq. ft. Each engine is provided with an automatic relief valve in the exhaust line, admitting to the 30-inch atmospheric exhaust riser, extending from each engine to the roof, where the riser is capped by an exhaust head.

Very complete platforms at three different heights are provided, giving ready access to all the working parts of the engine; and the two upper platforms have walkovers from engine to engine, facilitating efficient and economical supervision and oiling.

A flying bridge, which can be moved by the cranes, will span the aisle between the north and south row of engines. To borrow a scriptural idea, the engineer can literally "pick up his bridge and walk" without leaving it, and be carried from one end of the long hall to the other, with instantaneous access to any generating unit in either row. At the same time, when not in use, the flying bridge does not interfere in any way with the normal operation and employment of the cranes.

Wireless Telegraphy Across the Channel.

The London, Brighton & South Coast Railway has entered into an arrangement with the Marconi Company for wireless telegraph stations at New Haven, England, and Dieppe, France, the distance between which places is 75 miles. The departure of boats will be signaled, with instructions as to the number of passengers, amount of luggage and other information. This service will also be a great convenience to the public, as the friends of passengers will not, as in the past, have to wait for hours at the other end when fog has delayed a boat starting.

Regulation of Automobile Matters in America.

Important developments will probably occur within the next month in regard to the plan proposed recently by the Automobile Club of America, to make that club the national organization of America, and all other automobile clubs affiliated members of the national body. The rough draft of the plan has been sent to all the leading clubs in the country, but considerable opposition has been encountered. The *New York Times* has an interesting review of the situation. In Boston and Chicago the idea has not been favorably received at all, the clubs there resenting the proposition to acknowledge the superiority of the Automobile Club of America in all law and racing matters. The Long Island Automobile Club, at its recent meeting, did not view the proposition favorably. Automobile clubs throughout the country generally recognize the importance of a national body, but no clear idea has yet been advanced as to how this will be formed or governed. The affiliated clubs all feel that they should have some voice in the matter, and some plan may be evolved whereby the clubs in the national organization may have a vote in the councils, according to their membership. The Boston automobilists have been particularly agitated over the subject, and the Automobile Club of Massachusetts, the leading one there, has practically refused to meet the request for affiliation with the New York club. It is said that the Boston men, as well as members of many other clubs, are willing to yield first place to the Automobile Club of America, in view of its priority in the field and the many good things it has accomplished for automobilism, but that these members resent hotly every suggestion of a dictatorial policy.

The Long Island Automobile Club plan for a national organization was to have it composed of delegates chosen from automobile clubs at large, and they would make rules binding on all of the clubs. The Automobile Club of America has advanced the idea that its rules should be accepted by all these other clubs without question, they being affiliated members and accepting all rules in the broader field of automobile interests made by the main organization. This, therefore, is where the hitch comes in. The Automobile Club of Bridgeport, which has 34 members, has accepted the plan of the Automobile Club of America to affiliate with it and be governed by its racing and other general rules.

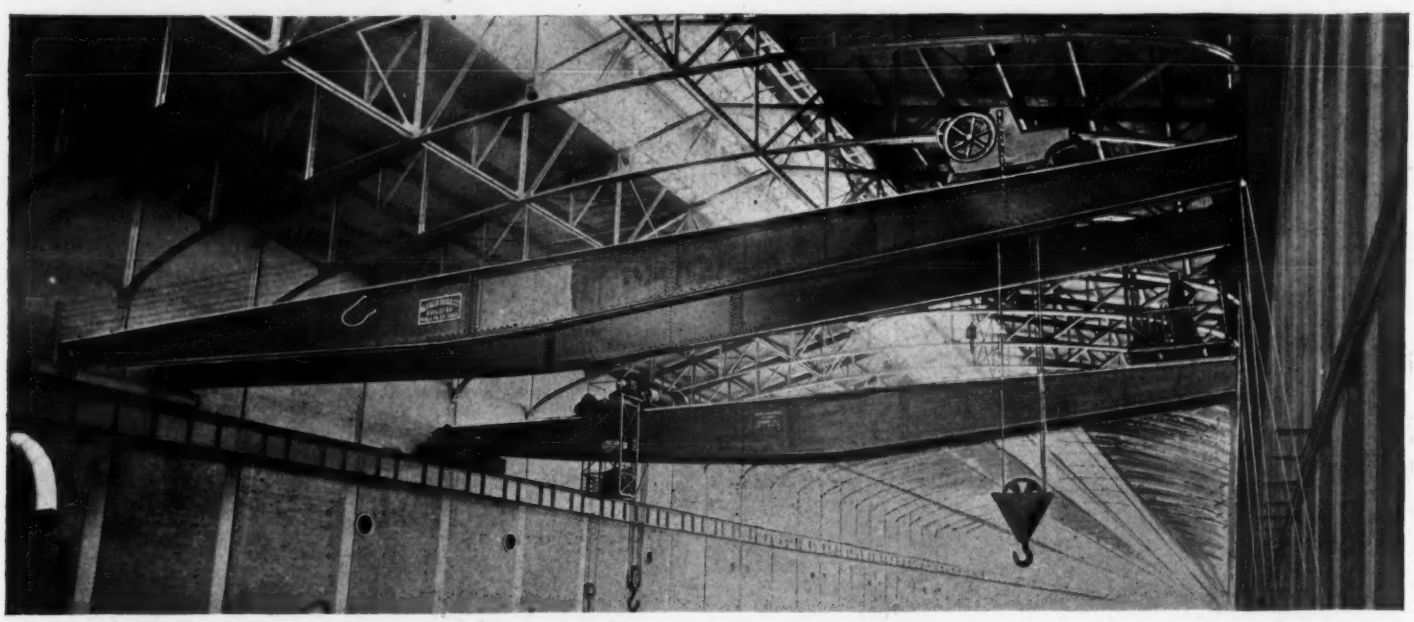


FIG. 14.—THE TWO ELECTRIC CRANES.

Two Recent British Electric Railways.

In the history of electric traction, Brighton, England, stands out as having been the possessor of one of the first electric roads—the electric marine railway of Magnus Volk. This road was discontinued many years ago, and it was not until November of last year that Brighton could again boast of an electric railway.

The present road has been built in the most substantial manner, the road-bed being laid on concrete and the feeders in underground conduits. The power house contains three Peebles-Willans units, one of 325 kw capacity and two of 175 kw; a motor-driven booster is provided for operation on the return circuit. Steam is furnished by Babcock & Wilcox boilers. The larger engine gives 467 brake horsepower at 320 r. p. m., and the other two engines each 250 brake horsepower at 350 r. p. m.

All of the engines are capable of giving 25 per cent overload for half an hour, and are fitted with automatic variable cut-off gear, and also by-pass valves, which enable the engines to give their full power with 150 lbs. steam pressure instead of the normal 175 lbs. The sets work without condensation.

The dynamos, which have been manufactured and supplied by Messrs. D. Bruce Peebles & Co., of Edinburgh, are of the multipolar flywheel type, compound wound for a pressure of 500 volts at no load, and 600 volts at full load. They are also designed to give an output of 25 per cent overload for half an hour, and 50 per cent momentarily without injury. In each case the armatures are of the slot-wound drum type, with ventilated cores, so that they will be suitable for running at full load for long periods, and the machines will run absolutely sparklessly at all loads from no load to over full load, without alteration in the position of the brushes. In the case of the small sets, the engines and dynamos are mounted on one combination base plate, whereas in the case of the larger dynamo, separate base plates for engine and dynamo are provided.

The motor-driven return circuit booster consists of two separate machines, direct-coupled end to end, and mounted on a combination base plate. The motor is a Bruce Peebles multipolar, shunt-wound, protected type, and is designed for an output of 40 hp when running at a speed of 800 r. p. m. It is designed to run off a 500-volt to 550-volt circuit, and will also give an output of 25 per cent over full load when required, and will run sparklessly under these conditions. The booster consists of one Bruce Peebles series-wound, multipolar machine, which is arranged to give an output of 1000 amperes at a pressure of 25 volts, varying down to 100 amperes at a pressure of 10 volts. The machine is provided with a suitable shunt across the series fields, to enable this regulation to be effected.

The switchboard comprises eight panels of polished white marble, consisting of three machine, three feeder, one booster and one Board of Trade panel.

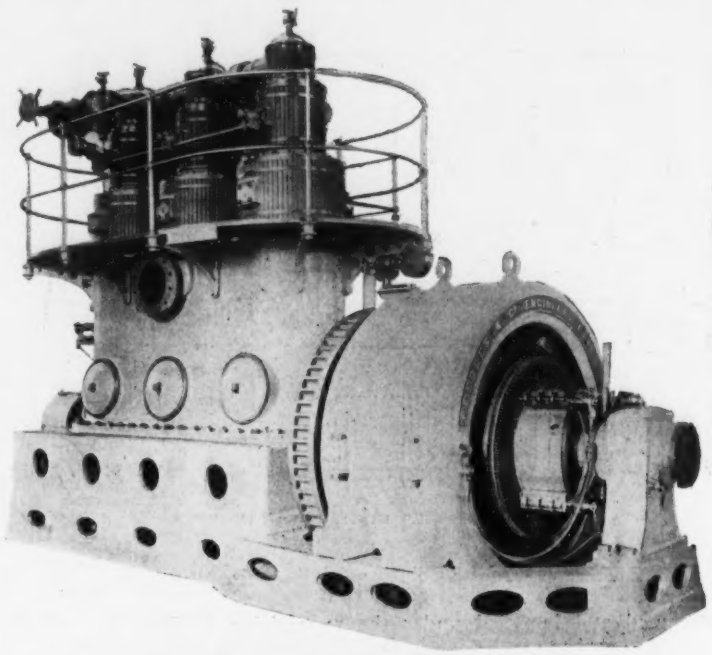


FIG. 2.—ONE OF THE GENERATING UNITS, BRIGHTON, ENGLAND.

Six and one-half miles of line have been laid, equivalent to 11½ miles of single track. Thirty cars are employed, all of which are equipped with British Westinghouse 49-B motors and No. 90 controllers. A system of electric signal bells has been provided in the cars, there being four pushes in the interior of the car and four on the roof for the convenience of outside passengers. In addition, a bell of distinct tone from the passengers' bell is employed on each platform for signaling between the conductor and driver.

The overhead construction was carried out by Robert W. Black-

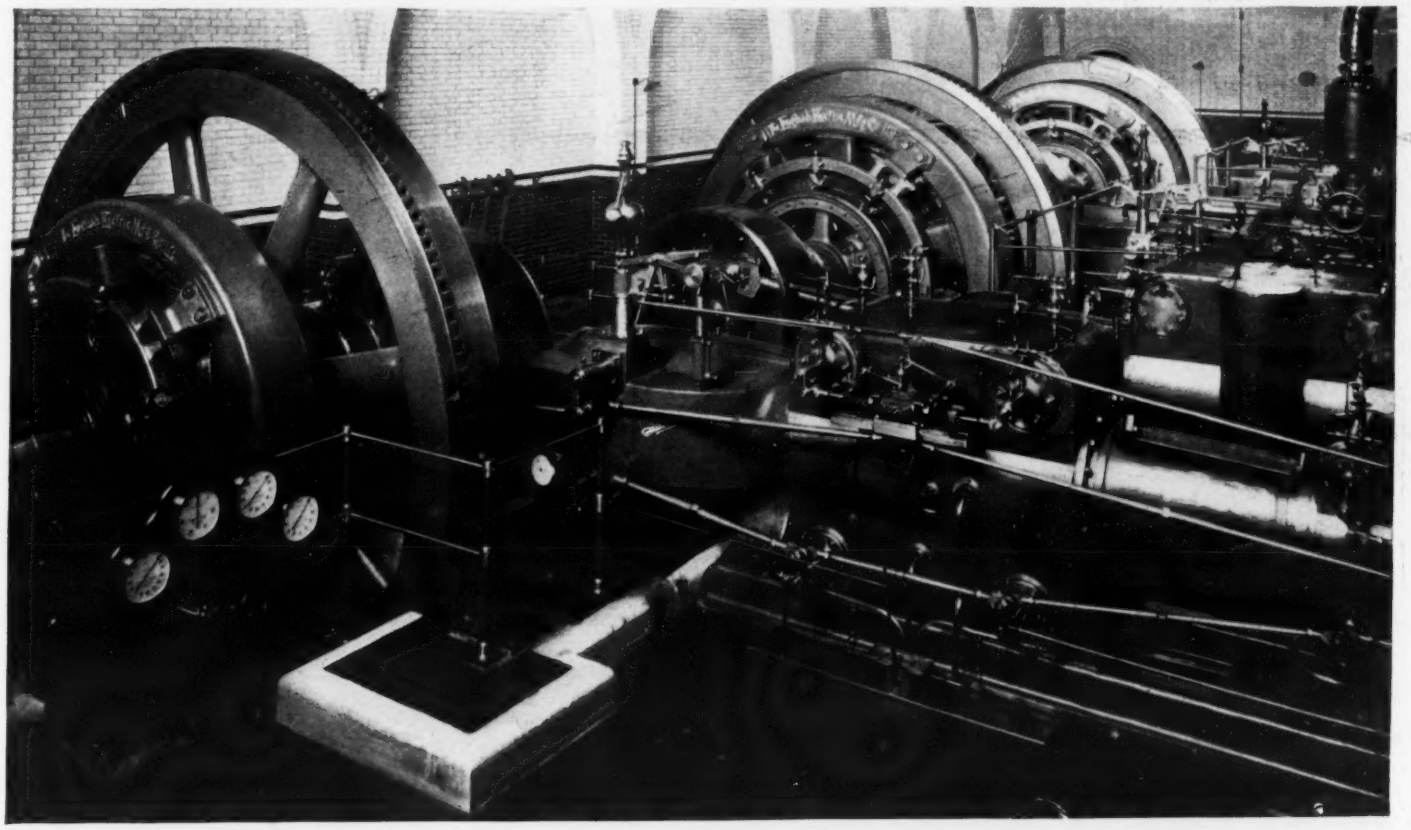


FIG. 1.—GENERAL VIEW OF ENGINE ROOM, PORTSMOUTH, ENGLAND.

well & Co. Brighton being a fashionable seaside resort, and as much of the route is through fashionable localities and along handsome parks, as great a regard as possible was paid to the asthetic point of view in constructing the trolley line. The trolley poles are drawn tubular steel, with bracket arms of steel tubing ornamented with wrought iron scroll work of elegant design. The road was

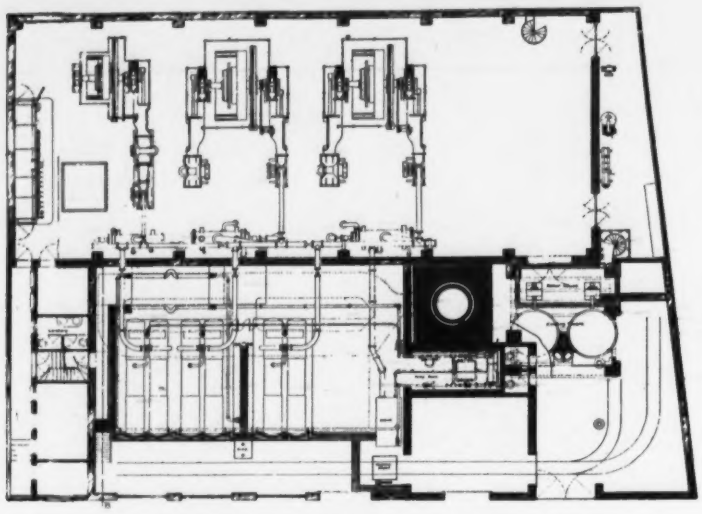


FIG. 3.—PLAN OF POWER STATION, PORTSMOUTH.

designed and installed under the supervision of Mr. Thomas B. Holliday.

Another recent English electric railway is that of Portsmouth, which is about being completed. The total length is approximately 14½ miles, there being 14 miles of double track and crossings, and ½ mile of single track.

The steam plant comprises three water-tube boilers and two horizontal cross-compound engines, each developing 640 hp under normal conditions, and having a capacity for a maximum of 900 hp. Also, a third engine of the horizontal tandem-compound Corliss type, which

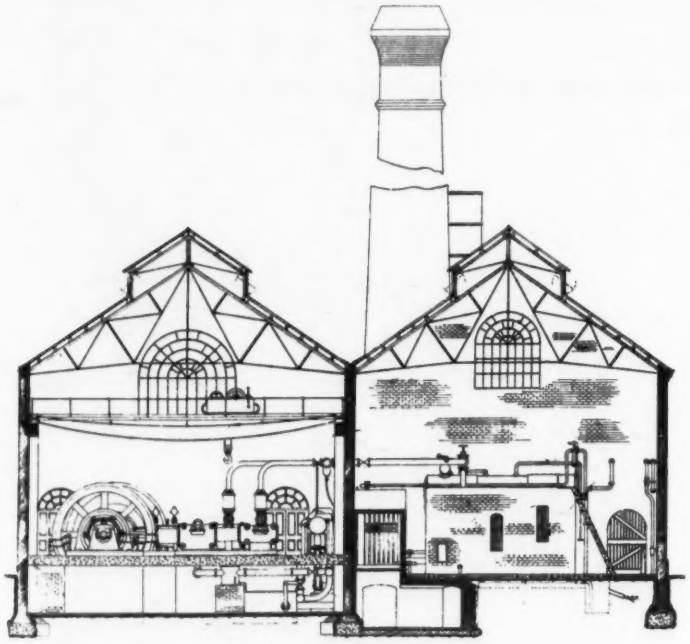


FIG. 4.—SECTION VIEW OF POWER STATION, PORTSMOUTH.

develops 320 hp normally, and 450 hp overload, the revolutions in each case being from 90 to 100 at a pressure of 150 lbs. per square inch. There are three surface condensers of the Worthington Admiralty type, two of which are capable of condensing under normal working conditions, 12,000 lbs. of steam per hour, and the smaller 6000 lbs. of steam per hour. There are three sets of combined air and circulating pumps with compound steam cylinders, the pumps being independent and each connected to one condenser. A Green economizer is employed, the scrapers of which are driven by a 500-volt Lundell motor.

The rolling stock will consist of 80 double-deck single-truck cars equipped electrically by the English Electrical Manufacturing Company.

The generators, which are three in number, are of the type generally supplied by Dick, Kerr & Co., and manufactured by the English Electric Manufacturing Company, with whom they are associated, and of which Professor S. H. Short is technical director. The output of the two larger ones is 400 kw, and that of the smaller one 200 kw when running at the rated speed under normal conditions. Each is provided with a long bearing surface to the shaft of the engine, to which it is to be fitted. It is bored accurately to a gauge supplied by the engine builder, and is made slightly smaller than the diameter of the shaft, so that it requires about 100 tons pressure to force it into position, it being then secured by means of two keys.

The switchboard is of the usual traction type, and is divided into panels, which are carried on vertical angle irons secured together with bolts, a suitable means being provided for fixing the angle irons to the floor and stays to support the board about 3 ft. clear of the wall. Automatic circuit breakers are provided on both generator and feed panels; all the instruments are of the usual type. There is a special panel provided to meet the requirements of the Board of Trade.

Plant of the Independent Electric Light and Power Company, San Francisco.

THE plant of the Independent Electric Light & Power Company, of San Francisco, is one recently built to compete with the company which formerly controlled the electric lighting business of that city. The engineers of the new company were given free hand to make the plant the very best possible for economical and reliable production of electrical energy. Mr. A. M. Hunt, consulting engineer, of San Francisco, and general manager of the company, has had full charge of the work.

In order to get a good location for the power house it was built on the Bay of San Francisco, some distance from the center of the city, and power is transmitted at 11,000 volts initial pressure to five sub-stations. One of these sub-stations supplies the San Francisco

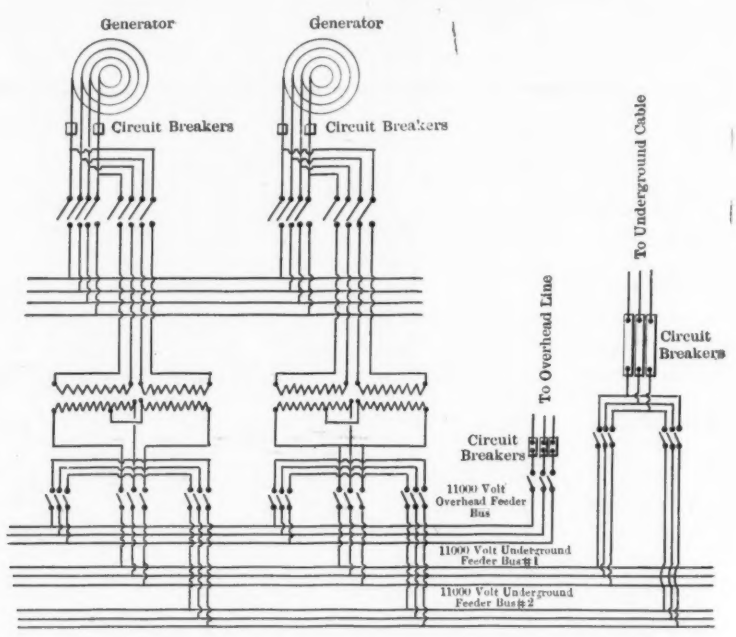


FIG. 1.—GENERAL SCHEME OF BUS-BARS, SAN FRANCISCO PLANT.

& San Mateo Electric Railway. Another sub-station is a combination from which both 500-volt direct current for the railway and 2000-volt alternating current for residence lighting are distributed. One sub-station supplies a 440-volt direct-current three-wire system, another one side of a 440-volt, three-wire system, and another 2000 volts alternating alone. The frequency is 60 cycles. The 440-volt, direct-current, three-wire system was selected for distribution in the downtown district, so that the company could bid for the business of many customers which had already purchased and installed 220-volt motors. In entering into a competition of this kind it was considered desirable to be able to connect with the motors already in place

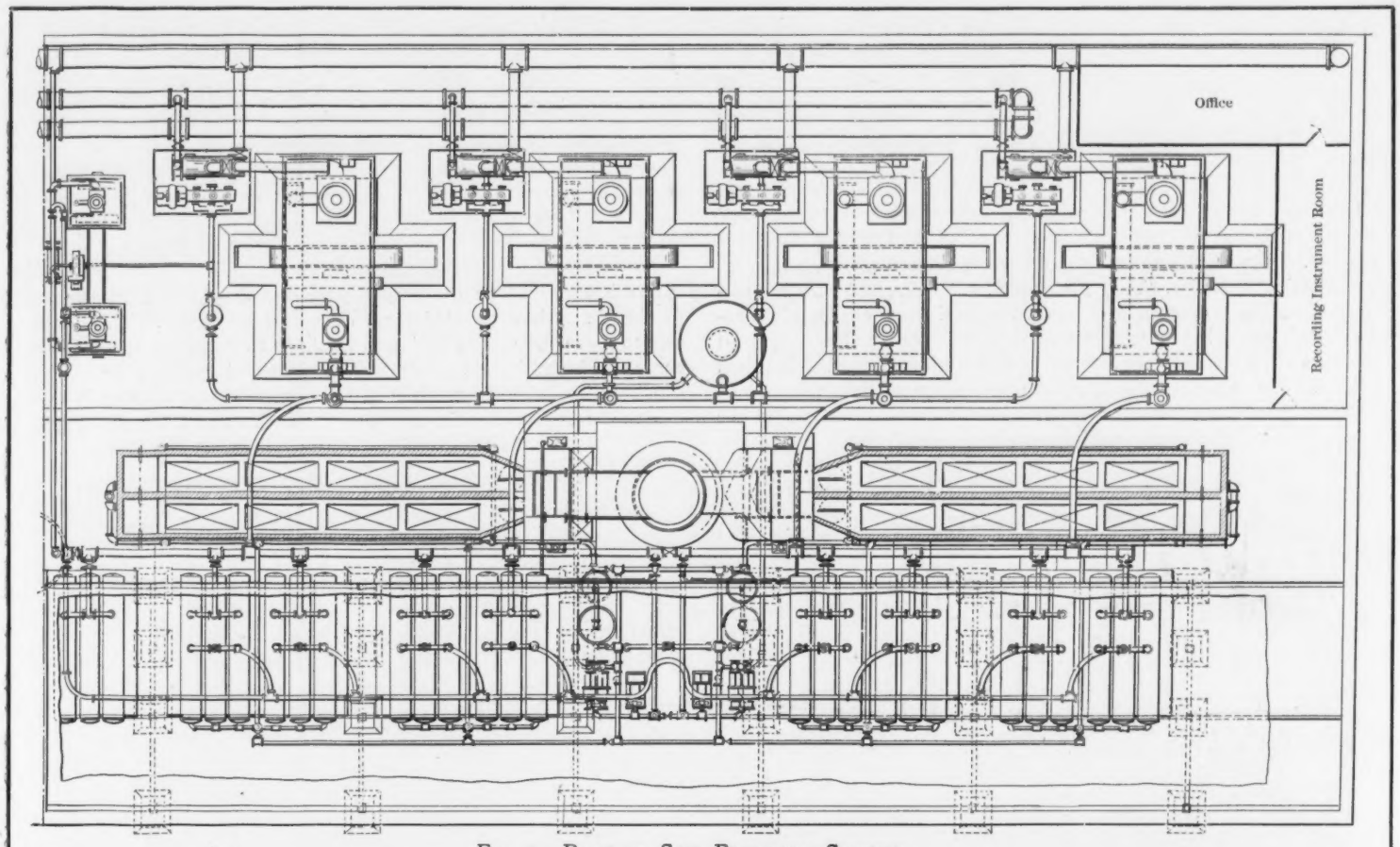


FIG. 2.—PLAN OF SAN FRANCISCO STATION.

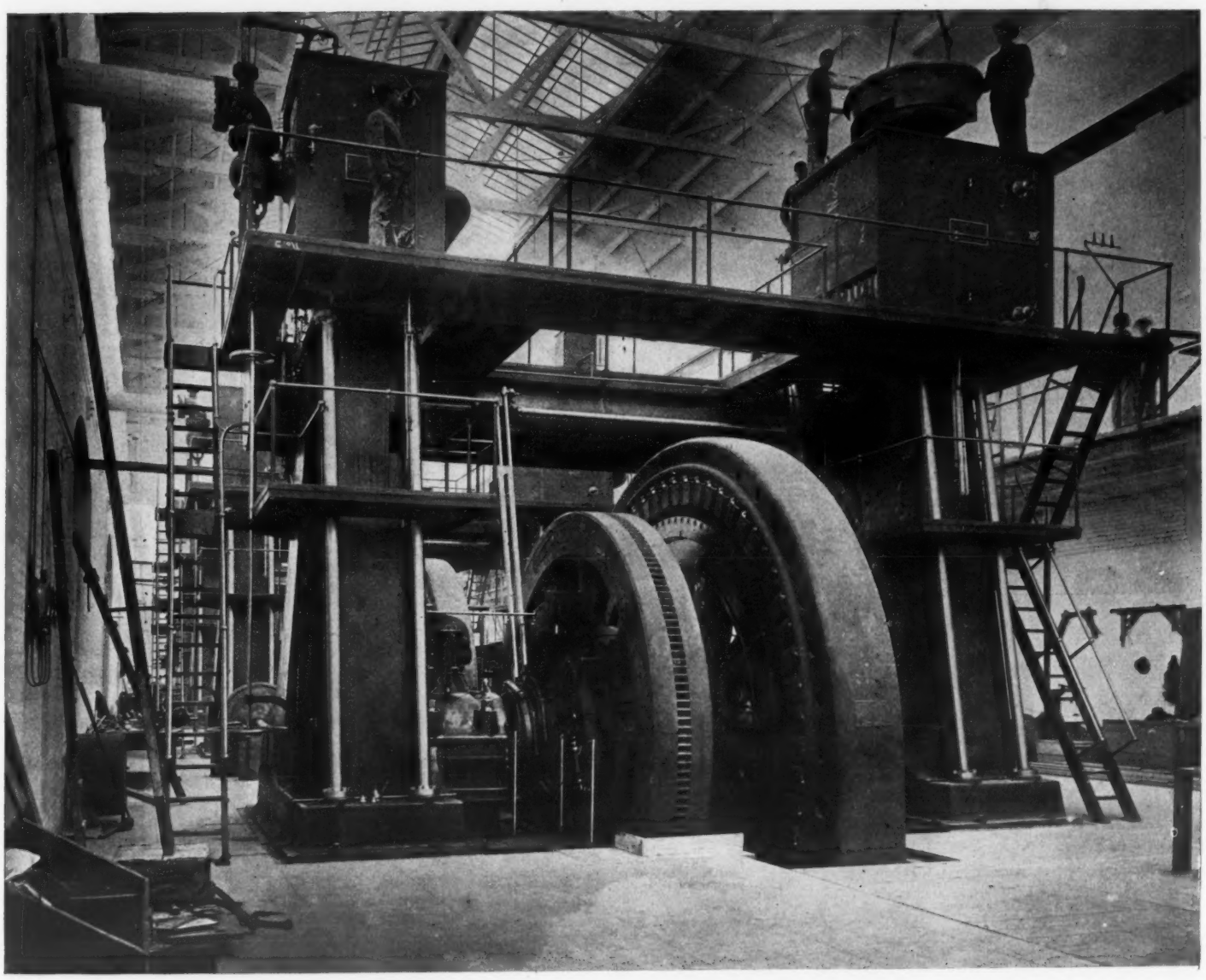


FIG. 3.—ONE OF THE UNITS, SAN FRANCISCO PLANT.
INDEPENDENT ELECTRIC LIGHT & POWER COMPANY, SAN FRANCISCO.

on customers' premises. The 10,000-volt distribution through the city is mainly by underground, lead-covered cables, with the three conductors in one sheath, though some of the outlying lines and the electric railway are supplied by overhead 10,000-volt lines.

Westinghouse electrical apparatus has been used almost entirely. The station has one 500-kw, two-phase Westinghouse generator and three 1500-kw generators direct connected to McIntosh & Seymour engines. These machines are the revolving armature type, with copper-sheathed pole tips. They generate at 550 volts, and each in ordinary operation is connected to its own pair of Scott-connected transformers for stepping up to 11,000 volts. The switchboard arrangement in this station has been the result of considerable study, and is worth noting. Fig. 1 shows the general plan of the station connections without going into unnecessary details, and without indicating the full number of feeders and generators. From this it will be seen that each generator is provided with two four-pole single-throw switches, one of which connects it to the low-tension bus-bars, and the other to its own bank of transformers.

In ordinary operation the generator is connected to its bank of transformers, and feeds the high-tension bus-bars in this way. The high-tension side of each transformer bank can be connected with one or all of three sets of bus-bars. One of these sets of bus-bars is for the overhead high-tension lines. The other set is in duplicate for connecting to the underground high-tension lines. If it should ever become desirable to connect the bank of transformers belonging to one generator with some other generator, it can be done through the medium of the low-tension bus-bars by raising the brushes on the generator which is not to be run, and closing both the switch connecting it with the bus-bar and the switch connecting it with the transformers. Then by closing the bus-bar switch connecting the generator with the bus-bars the generator can feed its neighbor's transformers by way of the bus-bars instead of feeding its own. There are five high-tension feeder panels, four of them for underground cables and one for the overhead circuits. These feeders are fused with long enclosed fuses mounted on a stick which can be removed to replace the fuse or to open the circuit by hand.

To synchronize a generator which has just been started up a small motor is mounted on the engine governor weight in the governor flywheel, and is controlled from the generator board. This motor acts to move the weight back and forth, and change the speed of the engine to bring it into exact synchronism with no load on. After synchronism has been attained and a new generator thrown in with those already working the motor is run back so as to move the governor weights and make the engine take its own share of the load as shown by the generator wattmeter. Current is taken to the motor through collecting rings on the engine shaft. Each generator panel has two single-throw, four-pole knife switches, an indicating wattmeter, a Bristol recording voltmeter, an indicating ammeter and voltmeter, and a magnetic circuit breaker in one leg of each of the two circuits.

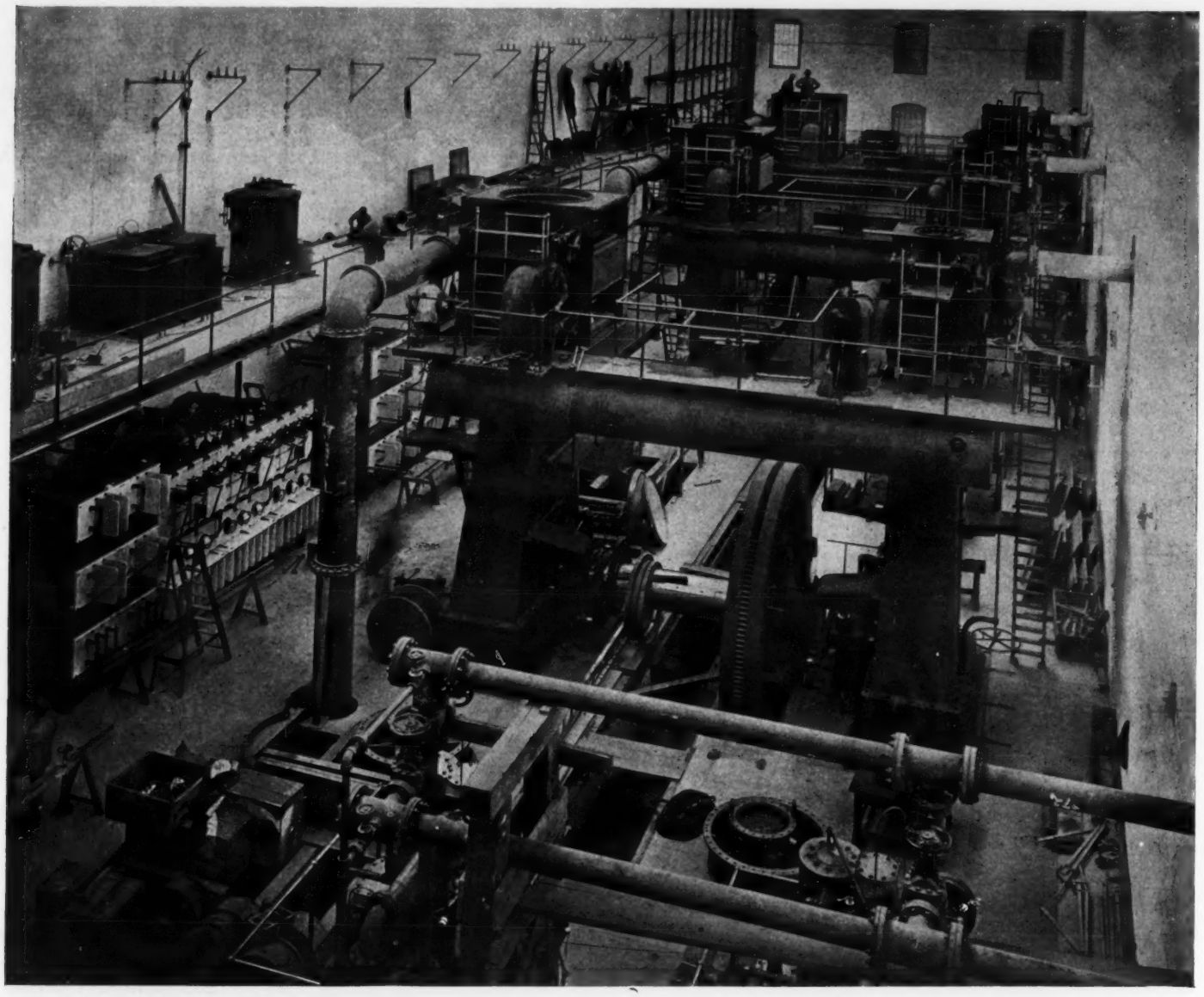


FIG. 4.—GENERAL VIEW OF GENERATING PLANT, SAN FRANCISCO.

The engines are cross-compound, vertical, condensing with overhung cranks, as seen in Fig. 3. The three 1500-kw units have cylinders 28 and 58 inches in diameter by 48-inch stroke, and run at 116 r. p. m. When operated condensing at 165 lbs. steam pressure they are rated at 2400 ihp. The 500-kw generator is connected to an engine 17 and 36 inches by 30 inches stroke, running at 160 r. p. m. The guides and main bearing shells are made hollow so that water circulation can be used if desired. There is a complete oiling system for

each engine supplied from a tank located on the upper platform, from which a system of piping leads to each place requiring oil. The main bearings have an independent system, the waste oil being caught in basins at the base and from there taken by a pump on the valve gear and forced to the supply tank at each bearing.

Each of the generating units is provided with a hand-turned gear operating against the flywheel for turning the engine while being overhauled or adjusted. This gear, of course, is thrown out of action when the engine is running. The four main engines have separate steam and exhaust valves of the gridiron type, driven by a main gear as usually furnished by McIntosh & Seymour. Special care has been taken to reduce radiation. Besides the usual covering all steam chest covers and cylinder heads have been provided with non-conducting covering and false coverings. The high-pressure cylinders are steam jacketed, and there are reheaters between the high and low-pressure cylinders. A great deal of care has been taken to adapt the engines to the exacting requirements of operating alternating-current generators in parallel. The flywheels are very heavy to bring the deviation from uniform rotation within the limits allowable in such work.

As mentioned before, the governors are of the centrifugal shaft type, with a speed changing device driven by a small electric motor on the governor weight. This not only allows the speed to be changed for synchronizing purposes, but the load can be shifted from one engine to another while leaving the engine under the control of the governor at all times. The dash pots of the governors are of sufficient sluggishness to prevent the governor responding to quick changes in speed due to electrical disturbances, such as hunting or pumping of the generators. The generators run well in parallel even with no load. One of the large units working at full load only rose 4.5 per cent upon sudden removal of this load. The ordinary rise in speed between full load and no load of this engine is only .46 per cent. The two engines driving the exciters are the vertical positive-valve high-speed type with cylinders 11 and 19 inches diameter by 16 inches, and run at about 200 r. p. m. These engines are center crank, and each exciter is connected directly to the end of the engine shaft. A seven-hour economy test of one of the large units has shown the consumption of dry steam at 160 lbs. initial pressure, and at 26 inches vacuum to be 12.75 lbs. The combined efficiency of engine and generator or the ratio of electrical horse power at the switchboard to the ihp of the engine was 89.5 per cent at full load.

The main steam and exhaust piping about the plant was made by the National Tube Company, and fitted with Chapman valves. A 16-inch main is provided between the engines and boilers, and it is connected to the engines by large radius bends of extra heavy 12-inch pipe. This steam piping and all bends are tongued and grooved. Stratton receiver separators are placed in the steam branch of the engines close to the throttle valves.

The boilers are Babcock & Wilcox water tube, with Green fuel economizers, the arrangement of which can best be seen by the accompanying engraving of a photograph taken during construction. They were furnished under contract by Charles C. Moore & Co., of San Francisco, who also supplied much other apparatus about this plant. There are eight boilers at present in full operation, and four more in course of erection. These are of the largest size regularly built by the Babcock & Wilcox Company, and are equivalent in capacity to five return tubular boilers 6 ft. in diameter and 16 ft. long. The boilers are arranged in batteries of two each, with a heavy division wall separating the furnaces and passages on either side so that each boiler may be operated, inspected and cleaned entirely independent of the other. The furnaces have 252 tubes 4 inches in diameter and 18 ft. long, connected to three main steam and water drums by sinuous forged steel headers. The headers when placed in position form sectional water legs at each end of the drum.

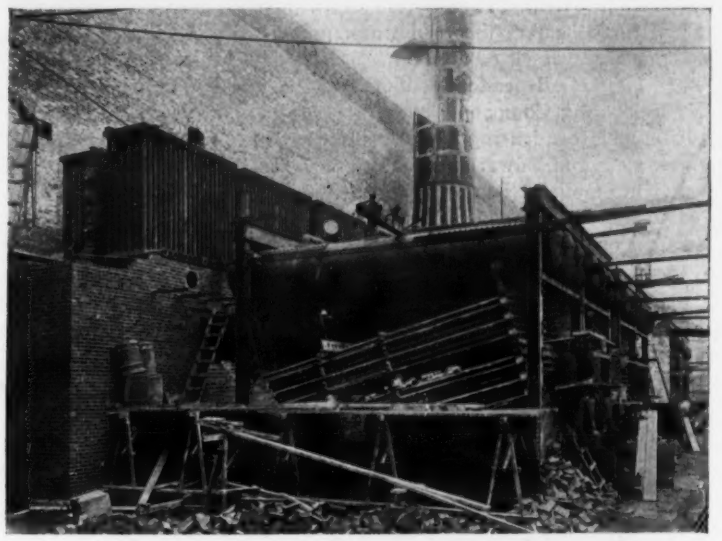


FIG. 6.—WATER-TUBE BOILERS IN COURSE OF CONSTRUCTION.

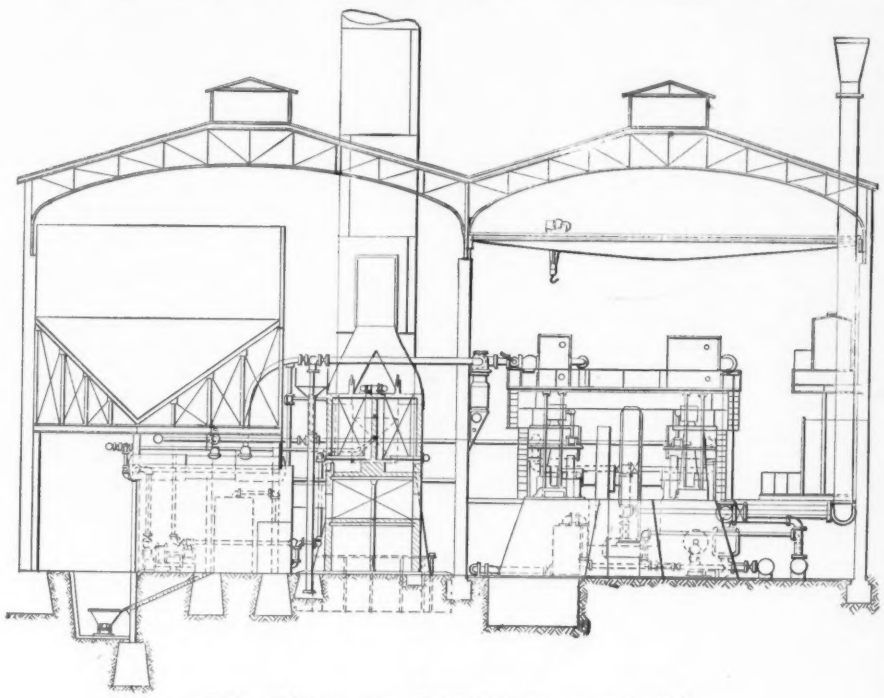


FIG. 5.—CROSS SECTION, SAN FRANCISCO POWER STATION.

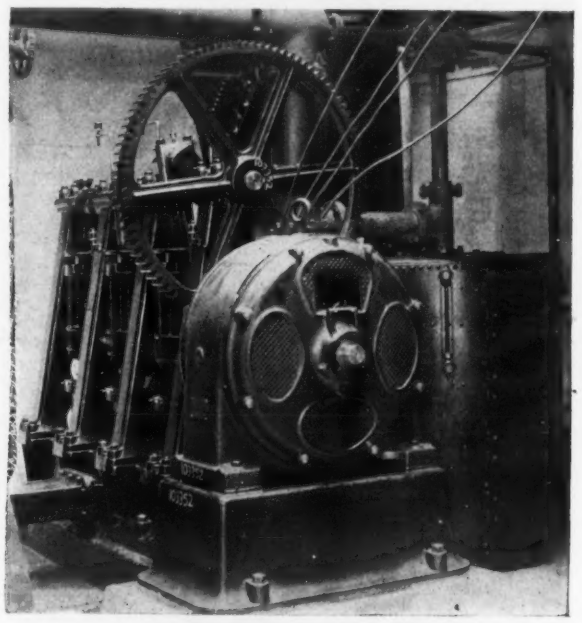


FIG. 7.—AIR PUMP DRIVEN BY INDUCTION MOTOR.

The boilers can be run with the hot gases passing through the Green fuel economizers or directly to the stack. The boilers, economizers and induced-draft fans are arranged symmetrically on either side of a self-supporting steel stack 125 ft. high and 10 ft. inside diameter. The economizers are separated longitudinally by a division wall so that only half of the economizers on either side of the stack may be operated if desired. A pair of induced-draft fans is placed

on either side of the chimney at its base. Each of these fans is 10 ft. in diameter, and operated by a horizontal direct-connected engine. Dampers and by-pass flues are so arranged that the gases from the boilers may pass either directly through to stack or through the economizers and fans. Feed water is pumped by three 2 by 6 by 10 Snow duplex outside center-packed feed pumps. The water passes from these through two large Goubert auxiliary feed-water heaters into which the exhaust steam is carried from all the auxiliary pumps. From these heaters the feed water goes to the boilers through the economizers. Each of the main engines, and the exciter engines exhaust into an independent condenser made by the Wheeler Condenser & Engineering Company.

The main condensing outfits consist of Wheeler Admiralty surface condensers and Edwards vertical triplex air pumps. The circulating water is supplied by an independent pumping station located at some distance from the power house at the water's edge, which supplies condensing water through a 30-inch main to all the condensers. Induction motors controlled from the power house drive centrifugal pumps for this purpose. Air pumps are also driven by 15-hp induction motors direct-geared to the crank shafts, as shown in Fig. 7. These air pumps have only one-third the number of pump valves ordinarily employed. From the fact that no induction valves are used either in suction connections or in pistons, this type is known as the "suction valveless" type. The only valves are in the discharge plates, which are easily accessible. A Quimby screw pump driven by direct-connected motors is used to pump the water for the transformer cooling. Part of the transformers, however, are oil cooled. The plant is operated by California fuel oil, the plentiful supply of which oil has caused it to be used almost exclusively for steam making purposes in the middle and southern portions of the State.

The Economic Design and Management of Telephone Exchanges—V.

BY ARTHUR V. ABBOTT, C. E.

II. THE CENTRAL OFFICE SITE.

SLIGHT allusion has been made to the impossible complexity of a telephone plant devoid of a central office, but as even some telephonists rarely recognize the full significance of "Central," and as the general reader seldom thinks of it save to anathematize some unfortunate operator, it seems desirable to point out in detail the enormous economic value of this factor.

Consider Fig. 1, in which at *A, B, C, D* and *E*, five separate groups of sub-stations are shown as indicated by small circles. At *A* there

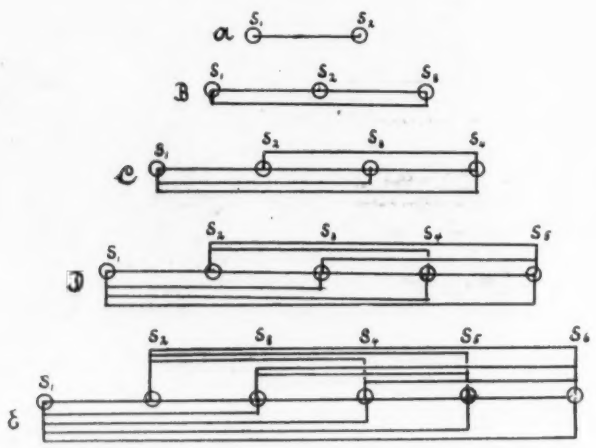


FIG. 1.—DIAGRAM OF CIRCUITS BETWEEN SUB-STATIONS.

are two subscribers, at *B* there are three subscribers, at *C* four, at *D* five, and at *E* six subscribers. Imagine in each case that between the subscribers, taken in pairs, a wire is strung in such a manner as to give the least number of lines to enable each one to talk to all the others in both directions. Such wires are represented by the full black lines joining the circles. At *A* a single one joining 1 and 2 will suffice. At *B* there must be one line between 1 and 2, and one between 2 and 3 and one from 1 to 3. At *C* there must be one between 1 and 2, and one from 2 to 3, one between 3 and 4; also one each from 1 to 3, and from 1 to 4, and lastly one from 2 to 4. Continuing this reasoning it is easy to see that if there are m subscribers in any territory, and supposing them to be numbered from 1 to m, consecutively, then there will be $m-1$ lines from the first subscriber; $m-2$ from the second; $m-3$ from the third, etc., to one line between the $m-1$th subscriber and the mth subscriber. The total number of lines will evidently be the sum of all these, or $\Sigma\, m-1+m-2+m+3+$ etc. $+1$. This is the sum of an arithmetical progression, of which the first term is $m-1$, the last term 1 and the common difference 1. The familiar formula for the sum of a series is

$$S = \frac{n}{2}(a+e) \qquad (1)$$

in which S is the desired sum; n the number of terms; e the last term, and a the first term. In this case $n = m-1$; $a = m-1$; $e = 1$. Therefore,

$$S = \frac{m-1}{2}(m-1+1) = \frac{m^2-m}{2} \qquad (2)$$

In Table No. 1 the value of S is calculated for a few of the most commonly occurring groups of subscribers up to 5000, to illustrate the rapid increase in complexity that such a system would cause.

TABLE NO. 1.

Showing relation between number of subscribers and number of lines needed with no central office.

Number of Subscribers.	Number of Lines.
2	1
10	45
100	4,950
500	124,750
1,000	499,500
5,000	12,497,500

Cases where there are a thousand subscribers or more grouped together are numerous, needing, as shown by Table No. 1, nearly 500,000 lines. A 200-pair cable, the largest now commonly used, needs (including space for ducts) about 25 square inches, so the 500,000 lines, should they pass a single point, would need 2500 200-pair cables occupying 435 sq. ft. space in the street, taking in its most compact form, at least 20 ft. square. Even the astonishing maze of pipes and other underground structures of New York streets would fade into utter insignificance beside such a scheme. Nor is the resort to an aerial line conceivable. A line with ten cross-arms carrying ten wires each is considered the largest justified by good practice, hence 5000-pole lines would be needed for a petty exchange of a thousand subscribers. By similar reasoning, it is easy to see that the first subscriber must have 999 lines, requiring five 200-pair cables or ten-pole lines to care for his wire plant only. The perplexities are not yet exhausted. Supposing one new subscriber to be added to an exchange of a thousand, then a thousand new lines must be installed.

A similar huge plant outlay, and corresponding space at each substation, is needed to enable connections to be made between subscribers. As subscriber No. 1 has 999 lines, he must have the same number of terminals so placed that any one can be connected to each of the others. At present, the jack with its connecting cord and plug is the most compact known form of switching apparatus, but a thousand jacks with their companion appliances would require a switchboard as large as a folding bed, costing at least $3,000. To be sure, but one pair of cords and plugs would be needed, and no supervisory signals, but all other switchboard apparatus would be essential. On each subscriber would fall the burden of doing all the switch work necessary to carry on his telephonic correspondence, no light task for people telephonically busy, and then the switchboard and wire plant must be maintained and kept in good working condition, a matter needing expert knowledge and unremitting attention. So, from all standpoints, "Central" is shown to be a great economic factor in telephony, saving not only a vast investment over any other conceivable method of attaining the same result, but relieving the subscriber of an otherwise impossible quantity of irksome labor, accomplishing the desired end with, on the whole, wonderful speed, accuracy and economy, facts which it is well to bear in mind the next time the gentle "Hello Girl" is a second or two longer in getting a

desired party, gives, perchance, a wrong number, or cuts off in the midst of an important sentence.

If, then, the central office is admitted to be a necessity, the best situation therefor is an important consideration. Unlike other location problems in electrical engineering, there are no questions of fuel or water supply, and no attention need be devoted to electrical losses in the radiating lines, so consideration relieved of these details may be focused sharply on the pure cost of the necessary installation, including therein the factors of real estate (land and buildings) and electrical plant.

If the operating company buys real estate (land and buildings), or if it purchases land and builds, it must treat itself as a landlord and charge against operating expense a sufficient annual sum to cover real estate maintenance, namely, interest on investment in land, interest and depreciation on buildings, expense or janitor service, light, heat, general building maintenance, etc., for the same. If the company rents office quarters from other real estate owners, the annual rental therefor covers the same items, plus a probable profit to the owners, and must be charged against operating costs in the same manner. Thus, in so far as the actual annual operating expense is concerned, it matters little whether the company, or other parties, are the owners of the necessary real estate, except that if the company owns, it may save to itself the interest on the real estate investment, or any other expense in the nature of a profit on the real estate transaction, and charge against operating only such a sum as is actually needed to perpetually maintain the buildings in proper condition, leaving the general profits of the business to care for any desired profit on the real estate portion of the investment.

There are other and weightier reasons in favor of a telephone company owning its own offices. A central office of any magnitude is a large, complicated and expensive installation. The nature of the wire plant renders a removal very difficult, costly and exceedingly detrimental to the service, even if conducted with the greatest skill and care, so permanence in location is of vital importance. Ordinary buildings are ill adapted to the uses of a central office, and if adapted it must be at considerable sacrifice of economy in plant installation cost, or at an increase in operating expense. Further, telephone apparatus is peculiarly sensitive to injury by fire, as the most insignificant one may completely paralyze the service for a considerable period of time, so particular pains should be taken to protect therefrom. Central offices, therefore, are preferably located in buildings more than ordinarily fireproof, thus even the presence of other occupants courts a fire risk that it is well to avoid. It is, therefore, safe to assume that ownership by the telephone company of such real estate as shall be adequate for at least the more important offices, say, those of 800 lines or over, represents the best present practice.

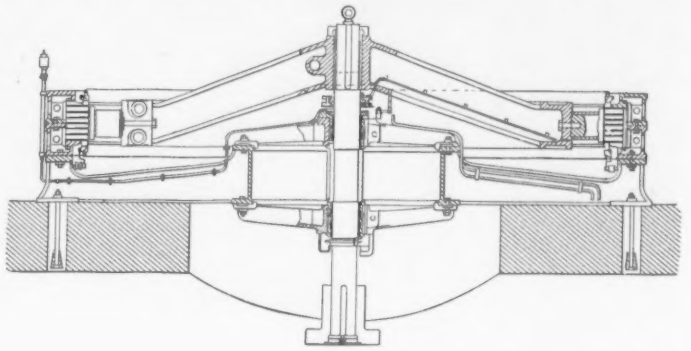
The design of the central office, including therein the choice of the necessary site, will affect the cost of four items in the telephone plant, namely, the investment in real estate, in buildings, in switchboard and in wire plant. So far as a discussion of the best location is concerned, two of these, namely, the type of switchboard and building, will remain essentially constant. For all kinds of switchboard need about the same space and other requirements, and the cost of buildings at any given time will be essentially the same, whether placed on one site or another of a particular city, provided, of course, that there are no exceptional peculiarities in the locations considered. But it is very evident that the cost of land will vary very widely in the same town, sites in the business portion costing many fold the price of equivalent areas in the outskirts. It is also evident that there must be some point within every collection of subscribers, such as would be presented by the groups in every city or town, from which the expenditure of wire to reach all the subscribers will be a minimum. To locate the office at this point, generally called the "telephonic center," will certainly require the least wire plant investment, and involve the smallest annual charge for depreciation and maintenance, because both the quantity of plant and investment therein is a minimum. As the office is moved away from the telephonic center, the investment in wire plant increases in a manner easy to calculate, but the cost of real estate will also change in some manner to be ascertained only by inquiry on the ground. The problem presented to the telephone engineer is then this: Given the location of the subscribers and cost of various central office sites, to determine, first, the telephonic center; second, the rate of increase in investment and annual expense of the wire plant as the office recedes from the telephonic center, and, third, to select such a site as will make the sum of the investment in land and wire plant, and the sum of the annual charges on both these items, a minimum.

The Debt of Electrical Engineering to C. E. L. Brown—VI.

By B. A. Behrend.

THE UMBRELLA TYPE.

THE great number of water powers in Switzerland of large volume and small head had early induced Mr. Brown to design generators with vertical shaft for direct connection to the turbines. We have referred to his designs for the Aluminum Works at Neuhausen, and more briefly to the 300-hp, low-tension, three-phase generators for the power transmission Bulach-Oerlikon. The very low speeds at which some of the turbines were operating demanded large diameters for the generators, and these large diameters would have made a top-bearing a clumsy construction. To this difficulty the "umbrella" type generator, so characteristic and typical of the



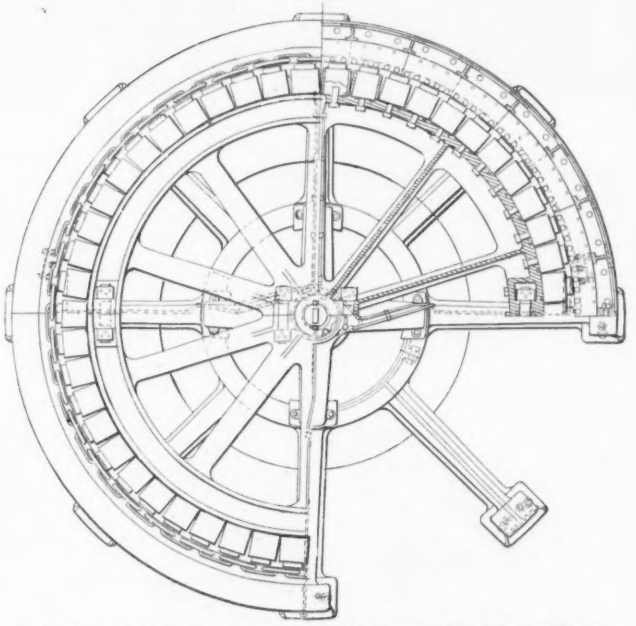


FIG. 30.—1200-HP, 120 R. P. M. GENERATOR FOR LYONS, FRANCE.

leading Swiss and French electric power stations, most of which are built by Mr. Brown, owed its origin. Never addicted to stereotyping designs, Mr. Brown deemed it better from an engineering and economical point of view to adapt the generator to the prime mover. The "umbrella" magnet wheel of one of the eight 1200-hp, three-phase generators for Lyons, France, is well shown in Fig. 33, while a drawing of the machine, a performance curve of it, and a view of the station are shown in Figs. 30, 31 and 34.

The cuts being very good, little comment on this construction is necessary. The normal output of these machines is 3500 volts, 200 amperes, at 50 cycles and 120 revolutions. The power factor of the circuit is 75 per cent. The normal rating of these machines is, therefore, 1210 kilovolt-amperes. These machines were designed in 1897, and are very well proportioned. The rise in voltage is small, viz., 100 volts, or less than 3 per cent on a non-inductive load of 150 amperes, and 500 volts, or 14.3 per cent on an inductive load of 200 amperes and power factor 75 per cent.

The "umbrella" type is also used by Mr. Brown for high-speed

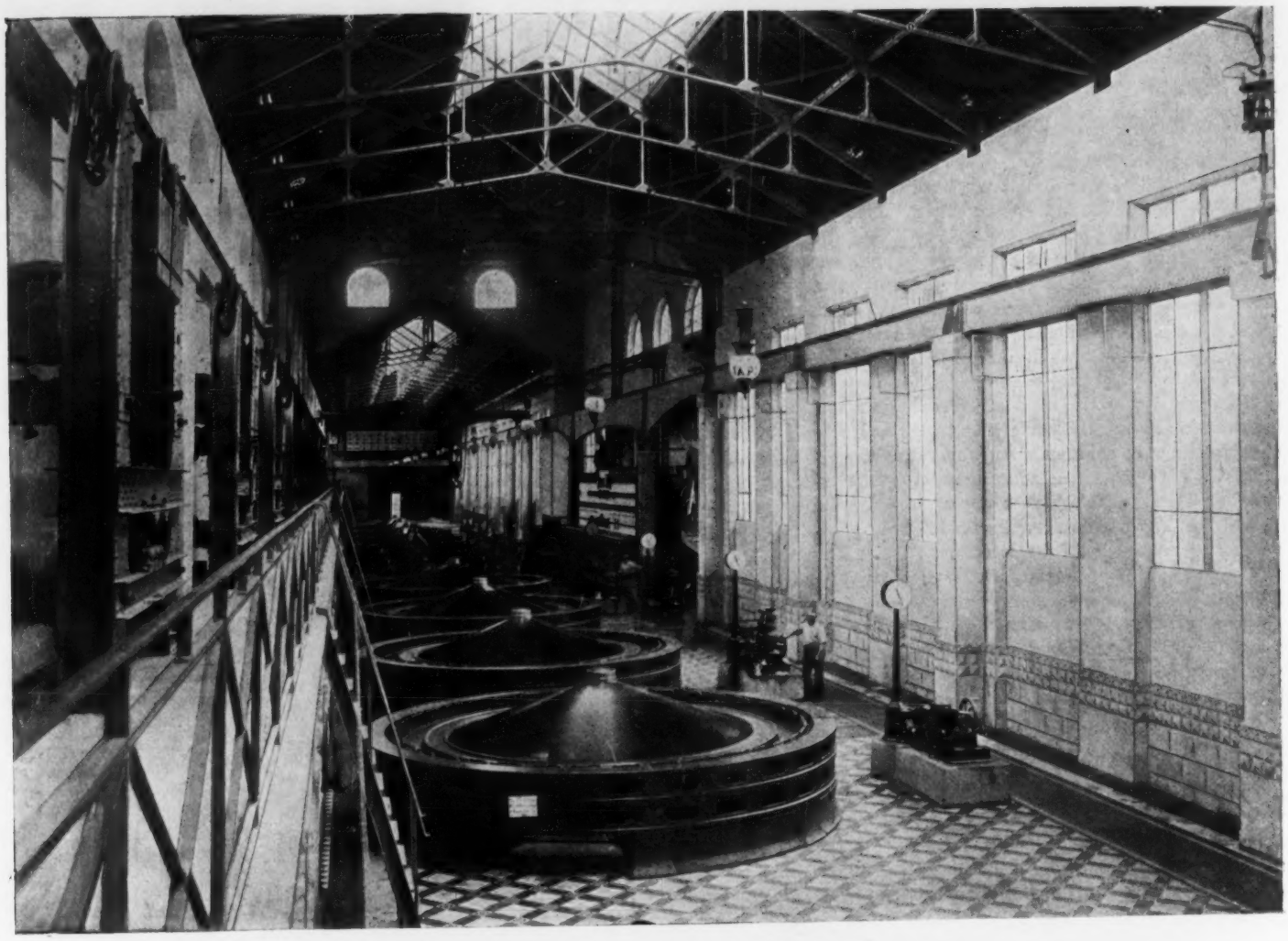


FIG. 31.—1200-HP GENERATORS IN LYONS STATION.

FIG. 32.—WAEDENSWEIL PLANT.

generators direct connected to the waterwheels. An early and typical installation of this kind is the plant on the Sihl near Waedensweil. The plant was constructed between 1893 and 1895. The design of the generators is shown in Fig. 35. They are rated to be capable of mak-

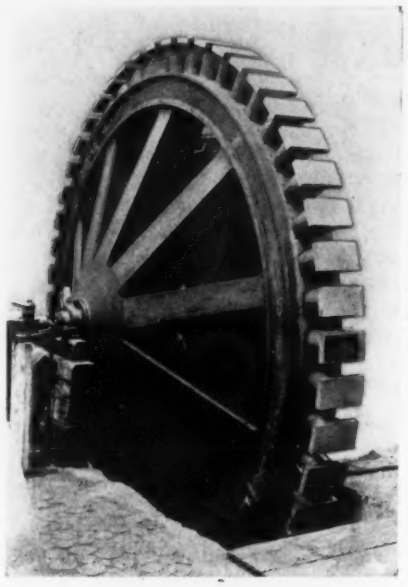


FIG. 33.—1200-HP REVOLVING FIELD UMBRELLA TYPE.

ing the turbines take in 400 hp at 360 revolutions and 42 cycles, either on a two-phase motor load, or on a single-phase lighting load. The pressure per phase is 5500 volts, the maximum current being 50 amperes. Thus on a two-phase circuit the generators would be 550-kw generators, and they are very well capable of yielding 550 kw on a motor load.

For the first time Mr. Brown used an extremely high surface speed

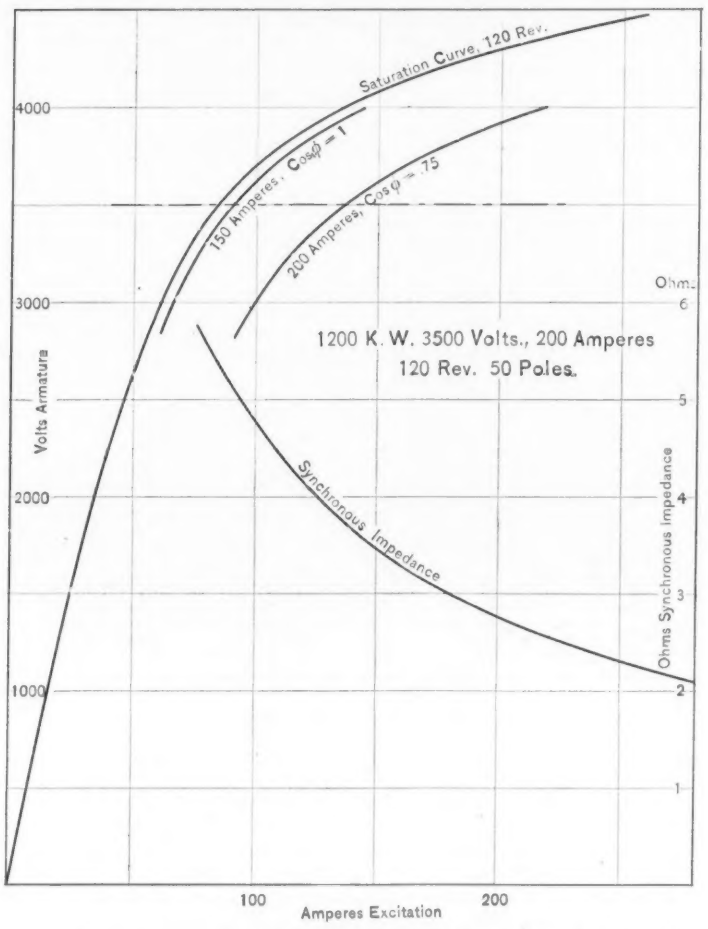


FIG. 34.—PERFORMANCE CURVES OF LYONS GENERATORS.

in these machines, viz., 7500 ft. per minute. Professor Wyssling, the manager of the plant, told the writer some years ago that by accident one of the turbines had raced and ran at 600 revolutions, corresponding to a peripheral speed of 12,500 ft. per minute without in the least injuring the generator.

The poles are held to the steel rim in a very simple but strong way; the winding consists of copper on edge, and thus the magnet wheel is in the truest sense of the word a part of the machine. The armature has four circular holes per pole, the conductors consisting of flexible cable, being threaded through insulating tubes made of mica and paper. It is a very simple and brief operation to re-wind an armature coil in this machine, but it is very rarely necessary, as the machine frame is carefully insulated from the earth, as shown in Fig. 35 to protect the machine against lightning. The floor of the room is set on insulators to protect the attendants.

There are at present four generators in the station, all alike. We say "all alike," and we have no doubt that electrical engineers familiar with the work of the past ten years will understand the allu-

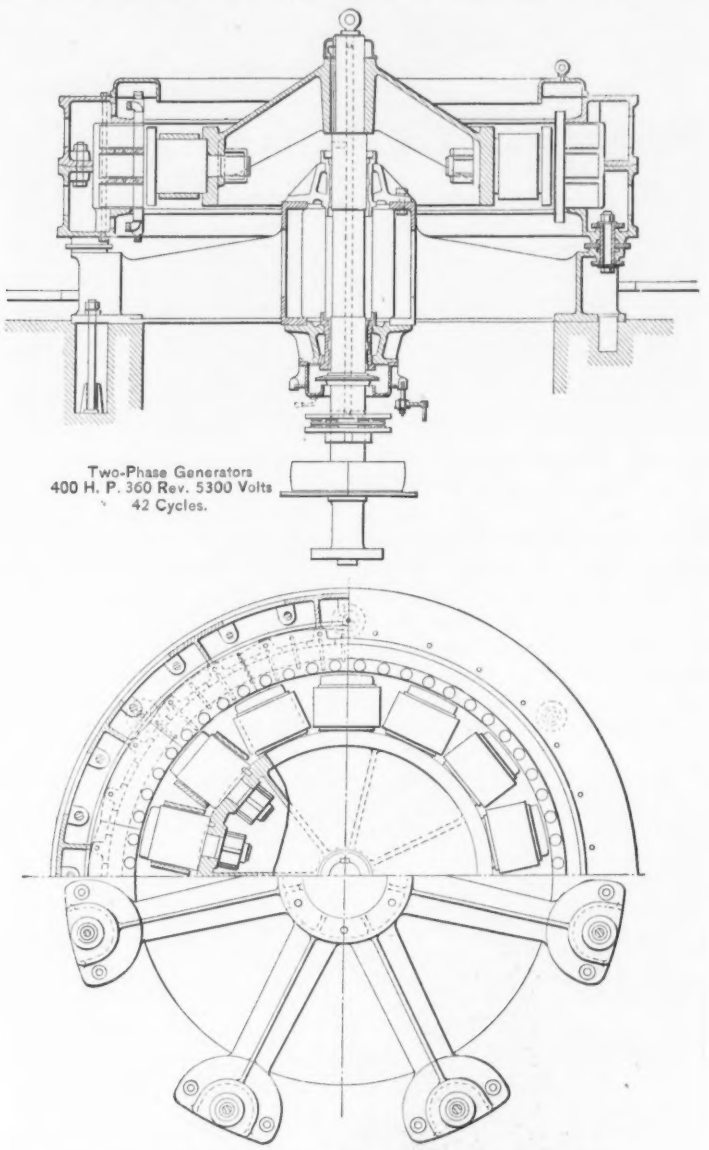


FIG. 35.—UMBRELLA TYPE GENERATORS AT WAEDENSWEIL.

sion. For it was not alloted to many designers of that time that they could make the second machine like the first. Nothing shows the real worth of the work of Brown so strikingly as the fact that with very few exceptions which we shall mention hereafter to disarm critics, he could make for one station all his machines alike, since the ones first installed had been designed rightly and required no changes. How many designers may say the same of their machines in the early half of the nineties?

Fig. 32 shows the generators in position in the station.

Cryptic "Contact."

The following cryptic, orphic dispatch of Dec. 24 hails from London: A new system of etheric telegraphy is being experimented with between Folkestone and Dungeness. The contact is said to be perfect.

Electric Generating Plant at Seoul, Corea.

Next to Thibet the most conservative country in the world has been Corea, which was only opened to the world in 1883. Up to that time but few Westerners, and then only at the risk of their lives, had seen the capital, Seoul. That Western ideas have been rapidly gaining ground, at least in the capital of the "Land of the Morning Calm," is made evident from the fact that the city now possesses an extensive electric railway system and an electric lighting plant.

The electric railway runs through the east and south gates, and a branch line through the west gate. The total length of the road is

FIG. 1.—CAR AT MAIN GATE, SEOUL.

10 miles, 5 miles of which are inside the city walls, and 5 miles outside. The terminus of the line outside the city is at the Han River, and recently an extension of 6 miles has been built to another point on the same river.

The prejudice of the people against the road was very strong at first on account of a superstitious belief that the power house was the cause of a dry season, which prejudice, however, is rapidly disappearing. When the line was first started two of the cars were burned and several demolished by a mob, partly on account of the

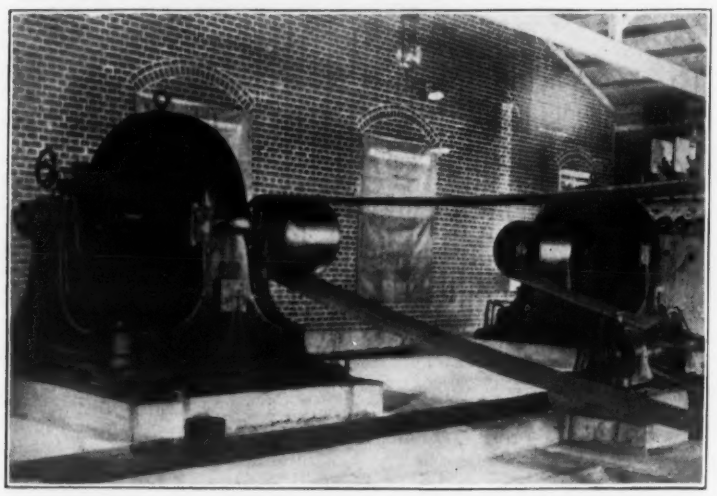


FIG. 2.—ONE OF THE GENERATORS, SEOUL.

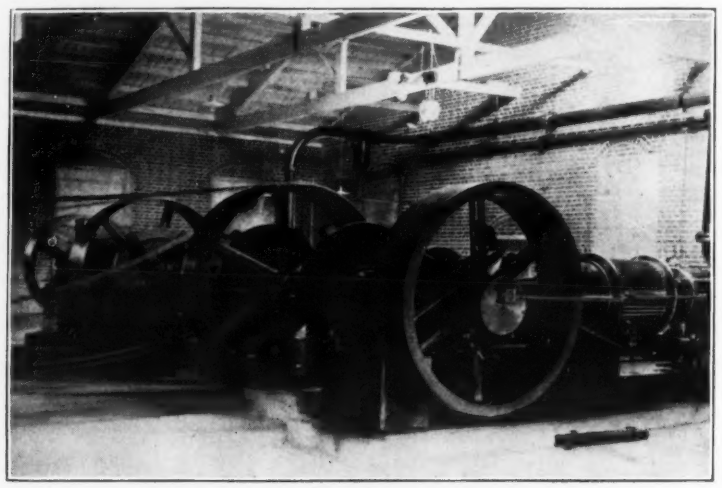


FIG. 3.—VIEW OF ENGINE ROOM, SEOUL.

above-mentioned superstition, and partly on account of the accidental killing of a boy by one of the cars.

The accompanying illustrations show one of the cars near the main city gate, and views in the generating house. The electrical generators were furnished by the Westinghouse Company, there being two 120-kw double-current machines. The alternating-current side delivers two-phase currents at 60 cycles for lighting the city and palace, and the direct-current side delivers current at 550 volts for railway service. The plant has also recently purchased a 75-kw Westinghouse rotary converter.

The engines were furnished by the Ball Engine Company, of Erie, Pa., and consist of two tandem compound engines of 230 hp running at 240 r. p. m.

Transatlantic Wireless Telegraphy.

Marconi has now made a thorough examination of the eastern portion of Cape Breton, and has decided to erect a station there fore transatlantic wireless telegraphy. It is stated that the erection of a station will be commenced within a few weeks, and that three months after the work has begun he will make practical tests in transatlantic wireless telegraphy from a fully equipped station. The electrical power employed at Cape Breton will be double that now used at Cornwall, and the power at the latter place will also be doubled. Instead of temporary expedients such as were employed in Newfoundland the installation will have a permanent character. A dispatch from Sydney, N. S., states that Marconi also contemplates erecting a station at Cape Cod, Mass.

One objection applying to a station on Cape Breton is that the messages will have to pass over a part of Southern Newfoundland. Marconi stated, however, that the land distance can probably be overcome by increased power at the station. It is to be seen whether the Cable Company will make any protest on the score that the passage of electrical waves over Newfoundland will infringe its monopoly. Should the land prove an insuperable physical difficulty, Marconi says that he will place a way station on the Azores, the King of Portugal having invited him to do so.

The Cape Breton Railway has offered to give Marconi the site and all land required for a station, and the Dominion Coal Company has made the same offer. The Commercial Cable Company is also understood to have offered him facilities at Canso.

To a reporter of the *New York Sun* Marconi stated that a wire 200 ft. high elevated by a pole or other contrivance, is sufficient for his purpose. After that all that is required is abundant electrical power for the generation of electric waves. The curvature of the earth, he says, does not injuriously affect the transmission. The contrary was one time believed, but the Newfoundland experiment has offered the necessary disproof. A more serious difficulty is the nature of the ground where the station is located. Some geological formations assist the apparatus, others minimize its effect. It is possible in certain spots to communicate over 200 miles, and in others only over 100 miles. The presence of iron deposits is injurious.

Referring to the use of the letter "S" in the Newfoundland experiments, the manager of the Cornwall station said that the letter "v" is usually employed in test signaling, and it is used between certain of the European Marconi stations. For the transatlantic test, however, this letter was avoided as a signal might have been received from another station. The test letter is changed from week to week, and when the transatlantic message was received at Newfoundland it happened to be the turn to telegraph "S." The manager of the Cornwall station said that he is in daily communication with a station in Ireland 220 miles off.

Scientific Meetings.

The American Physical Society meeting last week in New York City elected the following officers and trustees: President, Prof. A. A. Nicholson, of the University of Chicago; vice-president, Prof. Arthur G. Webster, of Clark University; secretary, Prof. Ernest Merritt, of Cornell; treasurer, Prof. William Hallock, of Columbia; trustees, Prof. E. H. Hall, of Harvard; Prof. D. B. Brace, of the University of Nebraska, and Professor Carl Barus, of Brown. The officers were all re-elected. The American Mathematical Society, in session at Columbia University, elected the following officers for the ensuing year: Vice-presidents, Professor Maxine Bocher, of Harvard, and Professor Frank Morley, of Johns Hopkins; secretary, Professor F. N. Cole, of Columbia; treasurer, Dr. W. S. Bennett, of New York; librarian, Professor D. E. Smith, of Columbia; committee on publication, Professor F. N. Cole, of Columbia; Professor Alexander Ziwet, of the University of Michigan, and Professor F. Morley, of Johns Hopkins. The president, Professor E. H. Moore, of the University of Chicago, holds over until next year. Professor Pomeroy Ladue, of New York University; Professor G. A. Miller, of Leland Stanford University; Professor P. F. Smith, of Yale, and Professor E. B. Van Zleck, of Wesleyan, were elected members of the council for three years.

Electrical Transmission on the Pacific Coast.

No better illustration of the great feats in electrical transmission on the Pacific Coast, of which so much has been heard of late, can be given than by the map on page 26. While the course of the Bay Counties Company system has been shown before, this, we believe, is the first adequate representation to appear in public prints of the territory traversed by the two great systems with proper regard to their relative geographical location.

A review of some of the interesting features of the "California situation," together with recent data, for which the *Journal of Electricity, Power and Gas,* of San Francisco, as well as our own pages, are authority, makes interesting reading, with the map before the reader for reference.

Through its connections with the system of the Standard Electric Company, power from the Colgate power house of the Bay Counties Power Company is now distributed in every day, hard, commercial service at a distance in excess of 200 miles from its point of generation. The manager of the local company, which is making its distribution—himself one of the most exacting electric lighting and power managers in the West—after having sufficient experience to satisfy himself, says: "I want no better power; it's good enough for me."

There was a time, not so very many years ago, when a transmission of 200 miles was considered beyond the pale of commercial feasibility, and there was also a time, not so very many months ago, seemingly, when it was said that such a transmission, if attained, would be beset with such technical and engineering difficulties as to relegate it into the category of experimentalism. Now, the fact has been demonstrated and all fears of either nature have been found groundless.

Several years ago, before Californian transmission enterprises had struggled into eminence, a certain financier who had to do with a transmission project of moderate proportions, was so battle-dooredand-shuttle-cocked by the conflicting opinions thrust upon him, that finally he began to believe the possibilities of electrical transmission a myth. At last an agent of the Stanley interests came along, and without entering upon pros and cons gave satisfactory guarantees that his company would accomplish certain results at a stated cost under prescribed conditions. The sales agent got the contract, his company has fulfilled its agreement, and certain prophets against electricity have gone down in ignominy, while now far larger and bolder schemes have proved their feasibility.

If it be regarded from an engineering standpoint only it is not an unmixed blessing that circumstances have compelled the temporary tying-in of the Bay Counties and Standard companies' systems. Let us, even at the risk of repetition, review the situation, which is giving now a phenomenal transmission line of over 200 miles in length. From Colgate to Oakland, the distance, by way of the Bay Counties' line, is 152 miles. From Oakland to Redwood City, by way of the Standard Electric Company's line, is 49 miles, hence the distance from Colgate to Redwood City is 191 miles. From Redwood City the Bay Counties' power is continued, by means of the secondary distribution of the Consolidated Light & Power Company, northerly along the peninsular of San Francisco to Burlingame for a further distance of 11 miles, making the total length of line from Colgate to Burlingame to be 202 miles. During this present month the Standard Company's high-tension line will be completed into the Eighth Street sub-station of the Standard Electric Company in the city of San Francisco, some 20 miles further than Burlingame, and when this is done the Standard Electric Distribution Company will have at its disposal, for use in San Francisco, electric energy developed on the Yuba River, 222 miles distant. This extraordinary long transmission will exist until early in the Spring of 1902, when it is stated that the Standard Company's great station at Electra, in Amador County, will be placed in service.

From Oakland, where the Bay Counties' line ends, power is taken backward, so to speak, over the Standard Company's line to Mission San Jose, which is the Company's main switching station, 26¼ miles distant from Oakland. Back again over the Standard Company's line from Mission San Jose to Stockton is a further stretch of 49.6 miles; hence the Standard line from Oakland to Stockton has a length of 75.85 miles, which added to the length of the Bay Counties' line from Colgate to Oakland gives a transmission that is 218 miles in length. This line has already been placed in commercial service, and is delivering 1000 hp to the Sperry Mills, the Stockton Gas & Electric Company and other industries of Stockton.

The experience of the six months which have passed since the inauguration of the extreme long distance transmission service from Colgate was begun, is that no further question need be raised concerning the reliability of the service. This does not mean that transmission service is to be regarded as infallible, but it does mean that the experience of the last six months has demonstrated, in so far as six months' experience will demonstrate anything, that extremely long- distance, high-tension transmission is possessed of no materially great hazard because of its exceptionally long lines or because of its exceptionally high potential. In fact, there is room for the contention that the qualifying adverb "materially" is unnecessary to the truthfulness of the statement, for with a power house as perfect as the central station of any city, and with every function of the equipment in duplicate even to the pole line, it seems justifiable to contend that such plants are surrounded with every safeguard known to the the highest class of electric service.

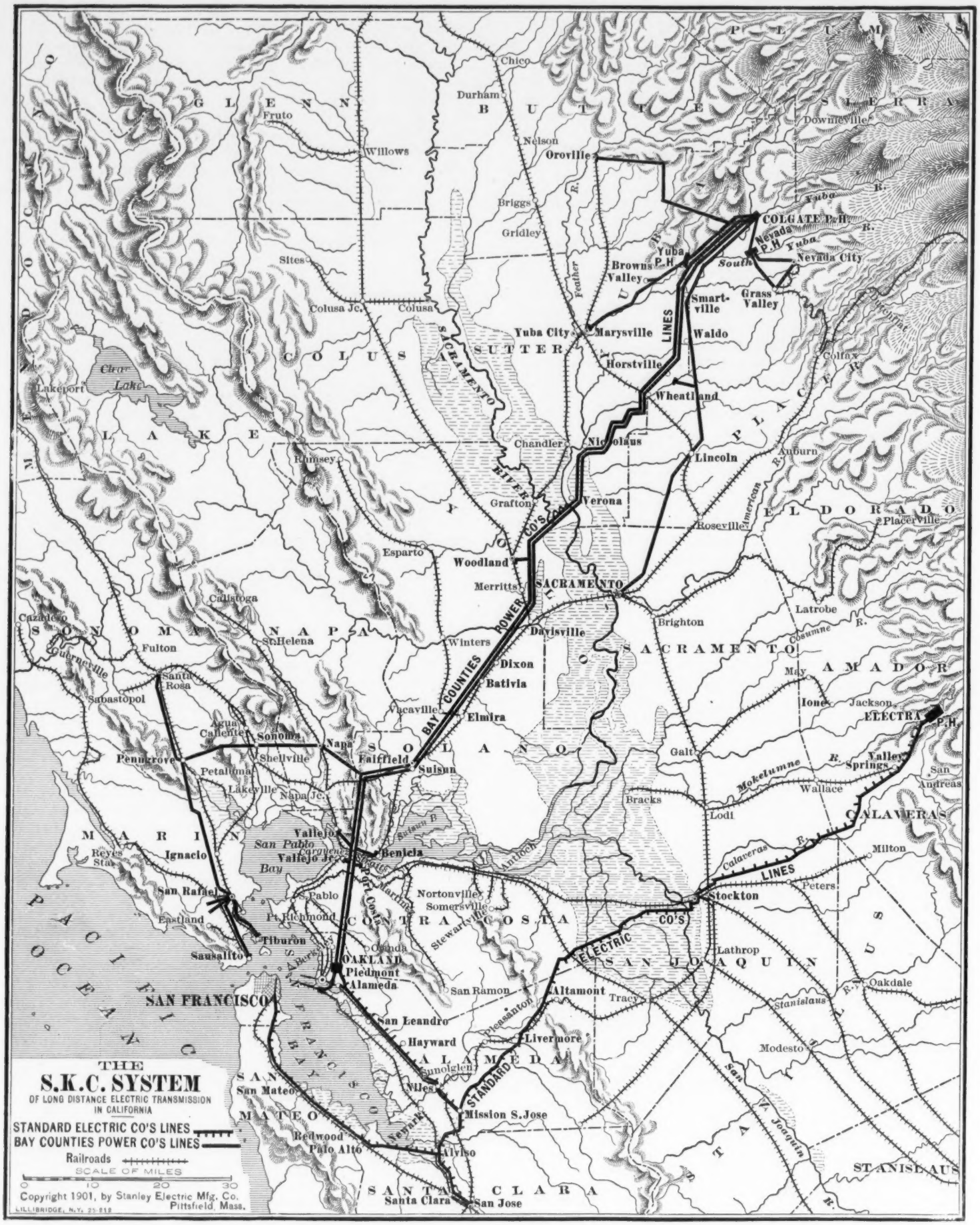
With the advances made in electrical science, the distance of feasible electrical transmission goes onward as the voltage values go upward. Eight years ago the lines of the old Pomona plant, which carried 10,000 volts, were viewed with awe and almost reverence. Now the use of 40,000 volts is becoming commonplace in California at least, and another six months will see hundreds of miles of transmission lines in the Golden State operated at a potential of 60,000 volts. Indeed, the Standard Electric Company has already operated one of its lines experimentally in adverse weather for over two hours at the extreme potential of 80,000 volts, and this without experiencing any trouble whatever.

Of the financial considerations attending the completion of the Bay Counties Power Company, concerning which there has been doubt and trepidation in ill-informed quarters, a few authentic figures, taken from the balance sheets of the Bay Counties Power Company, point out the moral in their own irrefutable way. The cost of the completed property of the Bay Counties Power Company was considerably in excess of the amount originally estimated, but as the demand for its power was also much larger than anticipated, the result has not been displeasing to the owners. The assets of the company on Oct. 1, 1901, amounted to $6,339,442.05. Of this $2,250,000 came from the sale of first mortgage 5 per cent, 30-year sinking fund bonds, and $750,000 from second mortgage 6 per cent bonds. Of the authorized issue of $5,000,000 of stock, 14,000 shares remain in the treasury of the company, hence 36,000 shares are outstanding, with a market value of $60. The monthly fixed charges for interest on the first mortgage bonds is $9,375, on the second $3,750.

The earnings of the six months (up to September, 1901) show a steady increase:

1901.	Gross.	Expenses.	Net earnings.
April	$13,913.21	$4,466.35	$9,446.86
May	16,195.76	4,590.86	11,604.90
June	18,219.78	4,217.11	14,002.67
July	20,903.46	6,674.15	14,229.31
August	24,185.70	6,033.51	18,152.19
September	25,463.52	6,864.59	18,598.93

In addition to the above gross earnings, the Bay Counties Power



MAP OF THE BAY COUNTIES POWER COMPANY'S SYSTEM IN CALIFORNIA.

Company has signed contracts to supply additional customers with power amounting to $15,000 per month. Further additional income will be obtained by the sale of the remaining unsold horse-power installed, calculated to amount to $10,000 per month, making a total gross monthly earning capacity of over $50,000, with an operating expenditure of not exceeding $9,000 for supplying such a service.

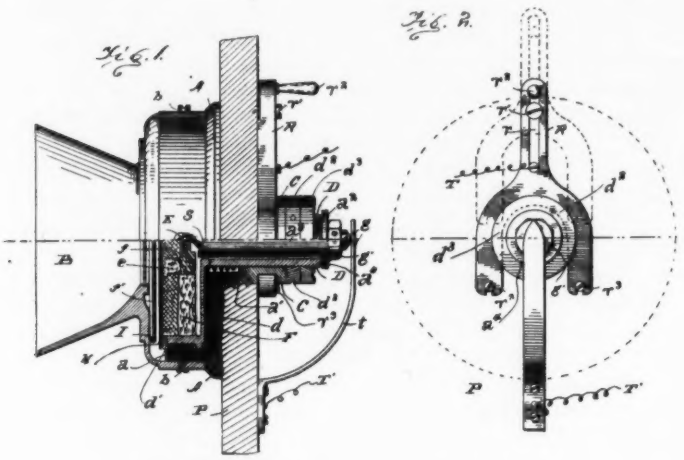
Surely, then, no qualification whatever is necessary to the statement that the commercial success of extremely long, high-voltage transmission is no longer undemonstrated in California at least.

New Telephone Patents.

Telephony contributes but two patents to the issue of Dec. 24, the inventions originating from points as far apart as Los Angeles, Calif., and Rome, Italy. Giving Marconi's countryman the place of honor, Commander Alfonso M. Massari patents a transmitter of the granular carbon type, in which the principal novelty is a means of adjusting the transmitter without taking it apart.

Referring to the diagram, *A* is a plate of insulating material having a central opening therein and carrying sleeves *a* a^1. *B* is the mouthpiece attached to sleeve *a* by screws *b*. *C* is a hollow metal cylinder having an annular groove *c* on its outer periphery, and an internal recess at one end, which fits over and is secured to insulating sleeve a^1. *D* is a tube having its free end threaded, *d* is a disk or flat ring having a central opening, to which one end of the tube *D* is attached, and d^1 is a short hollow cylinder attached to the edge of *d*. The tube *D*, ring *d* and cylinder d^1 are of brass or other suitable metal, and may be integral. The tube *D* passes through the plate *A* and cylinder *C* and has its threaded end projecting beyond the latter. *S* is a coiled spring situated between the ring *d* and a shoulder formed by the recess in cylinder *C*. All these parts are mounted on the baseboard *P*. On the free end of *D* is a nut d^2, secured by a lock-nut d^3.

The cylinder d^1 contains a carbon block or cup *E*, situated opposite the central opening in the ring or disk *d*, and held in position and insulated by chalk *F*; *f* is a piece of cotton or felt placed in the cup *E*, f^1 is a ring of cotton and *e* is granulated carbon. *H* is the diaphragm of metal and *I* an elastic ring, which separates and insulates the diaphragm from the mouthpiece. In tube *D* is fitted an insulated sleeve



MASSARI'S GRANULAR CARBON TRANSMITTER.

a^2 having an annular flange a^4 at its outer end. A metal rod *g g* passes through the sleeve a^2 and bears against carbon cup *E*; *g* can be regulated by nut g^1. The transmitter is held in place by fork *R* which fits the groove in *c* and is secured by screws r^2 and r^1 passing through the slot *r*. One line wire *T* is attached to *R* and the other T^1 to a contact piece *t* which bears on rod *g*. The circuit is thus through R_1 C_1 D_1, ring *d* and cylinder d^1, and through rod *g*, carbon cup *E* and granulated carbon *e*, the diaphragm completing the circuit.

When the instrument is in use the diaphragm vibrates and so varies the pressure of contact with cylinder d^1. The spring *S* normally tends to press the cylinder d^1, ring *d* and tube *D* toward the diaphragm. The nut d^2 acts against this spring and bears against the free end of cylinder *C*. The transmission is regulated by adjusting the pressure on the diaphragm, and this is effected by screwing up or unscrewing the nut d^2 and its washer d^3, and thus decreasing on increasing the pressure on the diaphragm. By this means a very delicate adjustment can be effected.

If the granular carbon becomes displaced, as sometimes happens in transmitters of this type, the mouthpiece and diaphragm can easily be removed by unscrewing screws *b* and the carbon can be replaced with little trouble. By drawing *R* into the position shown in dotted lines in Fig. 2 contact between the terminal wire *T* and cylinder *C* is broken, and the instrument can then be withdrawn from the base *P*.

The construction of this transmitter is ingenious and the means devised for securing adjustment should be effective, but the multiplicity of parts would render it rather an expensive instrument to make and the absence of necessity for adjustment when once the instrument has been properly assembled, has always been considered one of the best features of the granular carbon transmitter.

Mr. Samuel Judson Ballard, of Los Angeles, patents an indicator for extension or party lines intended to show at each station, by means of a dial and pointer, whether the line is "busy" or clear. The instrument is a simple mechanical movement actuated by an electromagnet. As the electromagnet of the indicator at each station must be permanently in circuit (Mr. Ballard shows them in series on one leg of the line) and as, to indicate "busy," a permanent current strong enough to energize all the magnets must be kept to line it is apparent that the Ballard indicator would introduce difficulties greater than those it is designed to obviate.

American Electrical Trade Abroad.

Our own pages show weekly the extent and scope of electrical export trade. The *World's Work*, in its January issue, presents the same data in a rather more spectacular and sensational manner, as follows:

Punta Arenas in Tierra del Fuego is the southernmost continental spot on the globe, but the modern lighthouse on that lonely coast is equipped with electrical machinery made in Schenectady, N. Y. The firm that manufactured it has also pushed electricity farthest north by installing dynamos at Hammerfest, in Norway, and, though it is a far cry from the deepest drifts of the Calumet and Hecla mine to Yanteles, in the Andes, 14,000 ft. above the sea, two consignments recently left Schenectady, one for the deep mine, the other for the mountain.

By the very bedside of the Pope is placed every night an American apparatus in the form of a cylinder with an incandescent bulb in one end—in effect an electric candle. At Bagdad, Aladdin has been replaced by a New York concern. Lamps of fanciful patterns are sent from New York to a point on the Persian Gulf, and thence conveyed over some 300 miles of desert on camel back. They are then placed on rafts and towed 100 miles up the Euphrates, and again loaded on camels and carried to their destination 200 miles from the river. These lamps decorate the palaces of the Sultan of Morocco, the Prince of Siam and several rajahs in British India, and they are also popular in Jerusalem.

From the Falls of the Couvery, one of the sacred rivers of India, to Kolar in Mysore, American electrical engineers have recently set up an American transmission plant under somewhat remarkable circumstances. There are still wild elephants in Mysore, and there will always be white ants. But as a white ant will venture not more than 5 or 6 ft. up a pole in search of edible wood, the steamer from New York carried out to India iron post-sockets 7 ft. high in which to set the poles—to the discomfiture of the ants. To disconcert the elephants and prevent grounding of the current through any behemoth that might venture to test the wires with his trunk, the engineers, after careful measurements, strung the wires just beyond reach of the biggest possible elephant standing on hind legs and groping.

Telephones in Chicago Restaurants.

The Chicago Telephone Company has inaugurated a novel class of service by placing telephone facilities within reach of the customers of several of the largest restaurants of that city. The restaurant is wired so that the telephone instrument can be plugged in at the various tables. It is then only necessary for a customer to ask for a telephone instrument if he wishes to carry on conversation with some outside party during mealtime. Kinsley's, the Bismarck, Mandels', Rector's and the Edelweiss have put in this service, and it is being extended to other restaurants. In the restaurants just named the charge per message is 10 cents, and is put on the customer's check along with the other items. In the Boston oyster house a different plan is employed. The telephone instrument in this case has a prepayment coin apparatus attached so that payment is made by dropping money in the slot instead of having it charged on the customer's bill. The plan seems to be a popular one, as some restaurants have as much as 15 to 20 calls a day for a telephone instrument from customers, even though the service is not as yet well known. The fact that the service exists is announced by neat placards at various places around the restaurant. The wording varies according to the idea of the restaurant manager, but in all cases the announcement is made that the waiter will furnish telephone instruments upon request.

Marconi on Wireless Telegraphy.

The *New York Journal* prints in its issue of last Sunday an article signed by Marconi under the head "Wireless Telegraphy in 1901." The article was evidently written some time ago, for the following passage—curious, in the light of recent events—occurs in connection with transatlantic transmission:

"I do not give any countenance to the suggestion of bridging over the Atlantic. The time for that is not ripe. At the present time it would necessitate the stationing of 10 ships. That would entail a very large expenditure. Then there is the question of the numerous re-transmissions which would be difficult in practice and be in no way an improvement either in cost or in time on the present cable system. I do not say that the idea is absurd, or unattainable, but its realization is out of the question for some time to come."

As to land telegraphy, Marconi says that nothing has as yet been attempted in exclusively land wireless communication. In England he does not see that it would act very well. Apart from the question of getting a license to do so, which, under existing circumstances would in itself be rather difficult, the present system of telegraphing could not be materially improved upon except for very long distances, and, he says, that he does not know that for that alone it would be a paying business speculation. In America the possibilities are greater, because of the larger areas and more open country. It is a question for the future. Meantime sea telegraphy is the great thing, and progress in this direction is more to be desired.

Referring to marine applications, he says that Great Britain has already 38 battleships fitted up with his system, Italy has 10, and Germany and France a dozen between them. But perhaps the greatest development that 1901 has witnessed in connection with wireless telegraphy has been its extension to the general shipping. There are at present four Cunard liners, four Norddeutscher liners, two Belgian Royal packet steamers carrying installation, and a number of other companies have fitted up the instruments as an experiment in one of their vessels.

As to syntonic telegraphy, Marconi says it is now possible to tune a message so that it shall go only to the ship or the object for which it is intended. This has been brought about by an alteration in the transmitters and receivers, and has resulted in a concentration of the electrical oscillations of each frequency. The improvement has been effected within the last year, but even yet when any reference is made to wireless telegraphy the erroneous impression, he says, is put abroad that the oscillations disturb other frequencies and so give to all the installations in the vicinity the message that was intended only for one. This new working has not yet been generally applied because in the generality of cases the old arrangement answered well enough, but wherever concentration is necessary the old instruments can be adapted to the improvements with very little difficulty and in a very short time. In other directions changes that have been for the good of the system have been carried out. Originally a very much higher pole was necessary. Every 30 miles required a pole 100 ft. in height. Now the same distance may be covered with a 10-ft. pole.

Government Telegraph Bills.

Postmaster General Payne, in his letter to us, noted last week, has formally and positively denied the rumors as to administration measures for securing control of the telegraph and his own share in them. But there are plenty of "private" bills from Congressmen. Congressman Brownlow, one of the Republican members of the Appropriations Committee of the House, in an interview, says, regarding the purchase of the telegraph lines by the Government: "I think the question will come before Congress this winter, and it is my opinion that some measure looking toward the purchase of the existing telegraph companies will pass the House by a pronounced majority. The telegraph is simply a quicker means than the mails for the transmission of intelligence, and it should be a part of our postal system. I am thoroughly in favor of the plan."

Representative W. A. Smith, of Michigan, who is the chairman of one of the important committees of the House, besides being a member of the Foreign Affairs Committee, is also strongly in favor of the purchase of the telegraphs, and says that it will probably be done through the issuance of 2 per cent bonds, which can be used by the national banks as a basis for their circulation.

Representative Pearre, of Maryland, who is also a Republican of some influence in the House, is preparing a bill, which he will introduce as soon as Congress reassembles, providing that the Government shall purchase the stock of the two telegraph companies, paying therefor bonds to the par value of the property and placing the telegraph business under the control of the Post Office Department.

Congressman Jackson has received promise of support from many members of Congress to his proposition for the government ownership of telegraph lines. He believes that the cost of transmission would be greatly reduced, even a 10-cent or a 5-cent minimum being possible.

It may not be generally known that every telegraph company that was in existence in 1866, and every telegraph company that has been organized since that time has filed with the Postmaster General of the United States its written acceptance under seal of the terms of the Act of Congress of July 24, 1866, agreeing thereby, in consideration of the right of way over post roads and through Government lands and under or across navigable waters, to transmit Government messages at rates to be fixed annually by the Postmaster General, and to sell its lines to the United States at a price to be fixed by arbitrators, one to be appointed by the Postmaster General, one by the company, and the third by these two. Mr. Payne's denial shows, however, that the Government has no intention of supporting any of these schemes.

Reorganization of Erie Bell Telephone.

The reorganization plan of the Erie Telephone Company, just announced officially, provides for the formation of a new company to acquire substantially all the assets of the Erie Telephone & Telegraph Company, which new company is to have a capital of $16,000,000 6 per cent preferred stock and $16,000,000 common stock, subject only to an indebtedness of $10,000,000 gold bonds. It has already been outlined in these pages. The $9,000,000 notes of the present Erie Company are to be paid. The 1928 and 1929 bondholders of the present Erie Company will be offered $800 5 per cent bonds of the new company, due in 1932, and two shares of preferred stock for each $1,000 bond. The 1909 and 1926 bondholders of the Erie Company are to be offered $1,050 5 per cent bonds of the new company due in 1932 for each $1,000 bond.

The holders of Erie Company stock will be given the opportunity to purchase the preferred and common stock of the new company upon the payment by them to Kidder, Peabody & Co., of $25 per share for each share of the present stock, each holder of four shares of Erie stock to be entitled to receive upon such payment one share of preferred stock, and three shares of common stock in the new company. Kidder, Peabody & Co., from the balance of the securities of the new company, are to sell a majority of both preferred and common stocks to the American Telephone & Telegraph Company, and are to buy and cancel the outstanding $9,000,000 notes of the present company and to pay into the treasury of the new company for the improvement of the plants of the subsidiary companies $6,000,000 in cash, which amount, it is estimated, it will be necessary to expend in the near future.

The bonds of the new company will be secured by all the securities now behind the several issues of debenture bonds and behind the $9,000,000 of notes, except so far as there may be an exchange of stock for notes of the subsidiary companies and except the shares and notes of the Michigan company. The preferred stock of the new company is to be 6 per cent, cumulative after two years from issue, and to have preference in liquidation. The portion of the stock issue of the new company which is to be offered the holders of the present Erie Telephone & Telegraph Company has been underwritten.

Automobilism in France.

It is announced from Paris that the Automobile Show closed on Christmas night after 15 days of unprecedented success. The final scene was the drawing of tickets of the free lottery, for which the best prizes were two automobiles. The estimated profits are from 80,000 to 100,000 francs, which will be evenly distributed between the exhibitors and the Automobile Club. A banquet to M. Rives, commissioner general of the exhibition, was given at the Automobile Club.

Charron, Girardot and Voigt announce the formation of a Franco-American automobile company, $1,000,000 being offered by American

capitalists and about $500,000 by French ones. The plan is to manufacture according to M. Charron's new models, which met with success at the Automobile show.

Messrs. Robert and Walden Shaw, of Chicago, accompanied by their wives, are ready to start on their automobile tour of Europe. Mr. Walden Shaw has chosen a French machine for his trip.

Coming Lecture on Nernst Lamp in Chicago.

Alexander J. Wurts, manager of the Nernst Lamp Company, of Pittsburg, will give a lecture upon and demonstration of the Nernst lamp at the laboratory of the Lewis Institute, Chicago, Friday evening, Jan. 10, 1902. This lecture was to have been one of the regular Chicago Electrical Association lectures, but owing to the difficulty of arranging for the lecture at the regular place and time of the meetings of that organization, Professor Woodworth, of Lewis Institute, arranged for the lecture to be held where the laboratory facilities of the Institute would be at command, and to invite the Chicago Electrical Association as a body to attend the lecture. Any other electrical men interested in the development of the Nernst lamp will also be welcome. This lecture will be the same as that already delivered by Mr. Wurts at Boston, Philadelphia and Cleveland, but will embody in addition some interesting new experiments, and will no doubt be largely attended, as it will be the first public opportunity offered the electrical men of Chicago and vicinity to investigate the Nernst lamp as a new factor in the lighting art.

German Appliances in England.

The *New York Times* is publishing with the *London Times* some very instructive articles on the industrial situation in England. In comments on foreign competition the following occurs: Though the foreign competition may not yet be extremely serious, it is undoubtedly severe, and the manufacturer to-day must be content with a very small profit on individual articles, depending for his gain on the possibility of turning out very large quantities. In the trade in electrical accessories, for instance, prices are cut so fine that there is hardly any profit at all. The development of the electric light has attained to so much greater proportions in Germany than in Great Britain that the makers of accessories in the former country have a distinct advantage over those in the latter. The German manufacturer will buy English china, mount his own brass work thereon, and send the complete article here, beating the English maker in his own market. A leading manufacturer says that when he has told his men of such things as this and shown them the foreign-made articles, the men have simply given him an incredulous smile, without in any way realizing the gravity of the position. Then there is the case of the electric light lamp holder, which is to the electric light what the burner is to the gas bracket. At one time the manufacture was protected in this country by a patent, and the holder sold for 1s. 8d. But the patent was not in force in Germany, and, as soon as it expired here, the German makers so flooded the English markets with their holders that the price was at once reduced from 1s. 8d. (40 cents) to 4d. (8 cents).

Franchises in the Philippines.

Among the recommendations of the Philippines Commission to the President in its annual report are the following:

7. That the commission be given power to grant street railway, electric light, telephone and other municipal franchises.

11. That the commission be given power to pass a law for the conducting of legitimate business of corporations.

There is nothing in the treaty between this country and Spain to prohibit the granting of franchises by the United States in the Philippines. Existing franchises are, however, protected by the following clause of the treaty: "The rights and property secured by copyrights and patents acquired by Spaniards in the Philippines and other ceded territories, at the time of the exchange of the ratifications of this treaty, shall continue to be respected."

Congress, on Feb. 26 of the present year did, however, as an amendment to the then pending army appropriation bill, adopt stringent regulations against the granting of any franchises in those islands. The language of the amendment follows: "Provided, That no sale, or lease, or other disposition of the public lands or the timber thereon, or the mining rights therein, shall be made; and, provided further, that no franchise shall be granted which is not approved by the President of the United States and is not in his judgment clearly necessary for the immediate government of the islands and indispensable for the interest of the people thereof, and which cannot, without great public mischief, be postponed until the establishment of permanent civil government; and all such franchises shall terminate one year after the establishment of such permanent civil government."

The Philippines Commission, of which Judge Taft is the head, in its report, now recommends that these restrictions upon the issuance of franchises be removed. Its recommendations have been approved by both the President and the Secretary of War, and it is confidently believed that Congress will adopt the necessary legislation asked for by the commission during the present session.

Preparing for the Commercial Pacific Cable.

Early during the present year Congress is expected to pay some attention to the question of an American Pacific cable, there being before it, as already noted in these pages, several bills proposing various schemes. Mr. George G. Ward, vice-president of the Commercial Cable Company, intimates that these measures will make no difference in the plans of his corporation. In an interview last week he said: "It would be inadvisable for the Government to undertake to construct a cable. In the first place, there is the matter of expense, not only of laying the cable, but also of keeping it in repair. It is doubtful if the Government could make as complete working arrangements with connecting lines so as to give complete service, as could a private enterprise, for diplomatic and business difficulties would quite naturally surround such a project if undertaken by the Government. It should be borne in mind that the Pacific Cable Company will be obliged to make arrangements with existing companies for business between various points in the Orient and Europe. This country could hardly expect to secure landing privileges or concessions where exclusive grants have already been given in foreign countries, notably Japan, to cable companies now in operation, and it is doubtful if a working arrangement could be made with such companies by this Government looking to any division of the business that these foreign companies now enjoy. No diplomatic difficulties, however, would be in the way of a private corporation making such arrangements. The Pacific Cable Company assumes all responsibility in the construction and maintenance of the new cable, thereby relieving the Government of any expense whatever, either for construction or operation."

The Silvertown Cable Manufacturing Company, of London, to which the contract for building and laying the Pacific cable was awarded a short time ago, has completed about 100 miles of the cable, and the remainder is expected to be finished in about eight months, when the cable will be shipped in special vessels around the Horn and the actual work of laying it begun. The section from San Francisco to the Hawaiian Islands is to be finished and in operation in some 9 or 10 months. The company will then proceed at once to complete the cable to Manila. This section will require a much longer time before it is finished, both on account of the greater distance and also because of the fact that the company will have to take soundings for the route. All the necessary soundings on the route from the Pacific coast to Honolulu were made some time ago by the Government. The total length of the cable from San Francisco to Manila will be between 7000 and 8000 miles.

Illustrious Electrical People.

Note has been made recently by our English contemporaries of a volume entitled "Lives of the 'Lustrious," which contains biographies of interest to Americans published in London. In November last Lord Rosebery, in one of his speeches, called biography "by far the most fascinating form of literature that exists," but he deplored the great abundance of bad biography. "It is in order to supply good biography, whose lack Lord Rosebery thus deplored, that the present monumental work has been undertaken." It is edited by Sidney Stephen and Leslie Lee. "Each of the editors makes it a personal request that all celebrities with a grievance will call on the other." We give below two of the biographies, one of Mr. J. P.

Morgan, and the other of Mr. Yerkes. We may premise that Mr. Morgan presented not long ago an electric lighting plant to St. Paul's Cathedral:

"Morgan, John Pierpont, Electrician to St. Paul's Cathedral, was born in 1837, with a golden spoon in his mouth. For many years he worked at the tiresome routine of monopolist, and only in 1901 reached his true vocation, the lighting of St. Paul's. Mr. Morgan has not yet decided whether to provide the motive power from Niagara Falls, or whether to buy up Buckingham Palace and place his engines there. In filling up a confession album in the house of one of our more affable Duchesses, Mr. Morgan stated Trust to be his favorite quality, and Steele his favorite author. Mr. Morgan's favorite game is Puss in the Corner, and his favorite song 'Johnny Morgan Lit the Organ.'"

"Yerkes, Edison Volta, Tubular Millionaire, was born in the Catacombs in 1841, and has been described by an enthusiastic Irishman as a 'rail gintleman.' Mr. Yerkes, after squandering upon America his lusty youth, descended upon the shores of this island a little while since, and by raising Tubal Cain, gave our railway system shocks. By passing an electric current along the metals, he claims to be able to stimulate porters to civility, station masters to humility, engine drivers to punctuality, and directors to decency. His name, which is usually pronounced as if it rhymed with that of his colleague, Mr. Perks, is rightfully a dissyllable, thus providing a much-needed rhyme to 'circus' and (at a very long distance) to 'work us.' Mr. Yerkes, who, as becomes one who has so many irons in the fire, is a great poker player, finds a Home from Ohm in the spacious hotel built on the Embankment by Lord Hugh Cecil, to accommodate the members of the Cabinet in consequence of their aversion to Downing Street. His motto: 'Tube be, or not tube be.'"

CURRENT NEWS AND NOTES.

WIRELESS IN KOREA.—The Japanese Minister at Seoul has notified the Korean Government that Japan has begun the erection of wireless telegraph stations along the Korean coast.

LONDON—BRIGHTON.—A new electric railway project is announced which is to have a line doing the 47 miles (we thought it was more) between London and Brighton in 30 minutes. Why not?

CANADIAN TELEGRAPHERS.—The federated railway telegraphers of the Dominion are feeling their way to the making of a demand for higher wages from the three great railway systems of Canada—the Candian Pacific, the Grand Trunk and the Canada Atlantic systems.

KANSAS TELEPHONY.—The Northern Kansas Telephone Association will hold a meeting at Concordia, Kan., on Jan. 6, when a number of papers and questions dealing with the problems of telephone service will be presented and discussed. This is the second semi-annual meeting of the Association. The president is Mr. T. M. Dolan, of Clifton, and the secretary is Mr. F. A. Daugherty, of Concordia.

GERMAN BEER AND ELECTRICITY.—The connection between lightning and lager is rather remote, but the *New York Evening Post* notes it as follows: So serious has the drawback of beer-drinking workingmen in Germany become, and so thoroughly is it recognized, that a movement has been started to exclude the drink from the factory premises. It has been not uncommon for a man to consume 10 pints a day in his shop, while the average is put at not much below a gallon per day, excess being especially marked among moulders. Several experiments have already been made in educating workingmen to dispense with the morning and afternoon recesses for beer, and one firm making electrical apparatus in Berlin has found an increase of 10 per cent in product per man since the change was made.

ELECTRICAL ENTERPRISE IN ENGLAND.—A cable dispatch from London of Dec. 28 to the *New York Times* says: There are signs that the district railways are about to push their contemplated improvements vigorously and intend, it is said, to oppose the projected branch of the existing electric line of the Central London to Hammersmith. Statements have been published this week that Mr. Yerkes is now likely to gain control of the Metropolitan, but though this is not believed, there is no doubt that the Metropolitan will now work harmoniously with the District. A cock-and-bull story was floating around this week to the effect that a new American syndicate had been buying canals on the Continent and trying to buy them in England, intending to introduce a new system of electric propulsion. The story was not credited.

DATA OF ILLUMINANTS.—In a paper recently read by Mr. Douglass Burnett before the Brooklyn Institute of Arts and Sciences the following comparative data of illuminants are given. The following figures refer to the intrinsic brilliancy or candle-power per square centimeter of various sources of light: Argand gas burner, at 1800 degs. C., 0.3; Siemens regenerative burner (one of the brightest gas lamps), 0.38 to 0.6; electric incandescent lamp, 40; Nernst electric lamp, 100; crater of an open arc lamp, at 3500 degs. C., 6400. For ordinary cases a square inch of gas flame emits 4 cp, whereas for the crater of an arc lamp the pro rata figure is 42,600 cp. The figures below refer to the optical efficiency, or the ratio of the light energy to the entire energy supplied: Argand oil lamp, 2½ per cent; naked gas flame, 5 per cent; electric incandescent lamp, 6⅓ per cent at 3 watts per candle; Nernst electric lamp, 13 per cent at 1 watt per candle; burning magnesium, 15 per cent; 5000-cp arc lamp, 25 per cent; sunlight, 25 per cent; the light of Geissler tubes, 33 per cent.

WIRELESS TELEGRAPHY IN U. S. NAVY.—The Navy Department has taken the initial steps toward the adoption of wireless telegraphy as a means of signaling between warships at sea. Admiral Bradford, of the Bureau of Equipment, has asked that the armored cruisers of the "Pennsylvania" class have their masts and rigging so arranged that the wireless system can be introduced. This will necessitate the lengthening of the masts of the ships and the insulation of the metal rigging by the use of hemp covering for halyards. It is intended to get test sets of instruments of the various wireless systems now being operated. These include the Marconi system. Thus far, however, the Navy Department has not adopted definitely any system, but the construction of the new ships is regarded as a preliminary to the adoption of a system whenever its practicability is established fully. The Navy Department has also decided to establish wireless telegraph plants at the Washington Navy Yard and at Annapolis. The plans for the necessary equipment of the two stations are being worked out under the direction of Admiral Bradford. Experiments will be under way soon. At each point a tall mast is to be erected for the purpose of receiving and transmitting signals. Small buildings are to be erected for the installation of the instruments, etc.

SIR WILLIAM PREECE.—With regard to wireless telegraphy the *New York Tribune* has the following appreciative item: There was something rather exceptional in the encouragement given by Sir William Preece to Signor Marconi when the latter first arrived in England, his adopted home, in 1896. The young Italian had only attained his majority at that time, and was practically without friends. The experiments which he had previously tried on his father's estate near Bologna had satisfied him that the principle involved was sound, but they were of a rudimentary character. In order to develop the system sufficiently to interest capital, more elaborate and costly tests were requisite. Sir William, then at the head of the British telegraph service, soon heard of the newcomer. But he had himself been working for ten years on another scheme which dispensed with wires, and with a moderate degree of success. Under the circumstances it would have been only human to ignore Marconi, if not to put obstacles in his way. Instead, he offered a helping hand, though he quickly discovered that the new system was superior to his own. Before the close of 1897 Marconi had shown that Hertz waves would penetrate the solid masonry of city buildings, and on an open plain like that of Salisbury travel for miles. A year later communication was opened up between the mainland and the East Goodwin Lightship, and also between the Isle of Wight and Bournemouth, and early in 1899 the English Channel was crossed. But it is doubtful whether any of these achievements would have been recorded so soon, if at all, had it not been for Sir William Preece's generosity.

AFGHANISTAN AGAINST ANYTHING.—At a great durbar held at Cabul recently the new Ameer, Habib Ullah Khan, addressing the assembled chieftains, promised to maintain the policy of his father, the late Ameer, in guarding Afghanistan against foreign aggression, and in preventing the introduction of railroads, telegraphs, European trade and education by missionaries.

NEW HAVEN THIRD RAIL.—Work is beginning on the New York, New Haven & Hartford Railroad Company's improvements of the third-rail system between Hartford and Bristol, about 19 miles. Higher voltage alternating dynamos are to be placed in the Berlin power house, heavier copper wire installed, and at Hartford, New Britain and Bristol will be placed sub-stations with transformers. The third rail is to be improved, the outer rails rebonded, and the cars geared for higher speed. A uniform voltage for all service is to be established. A more frequent express service between Hartford and Bristol is another feature of the plan.

THE LONGEST TROLLEY YET.—A report has been current in Indianapolis that Hugh J. McGowan, president of the Indianapolis Street Railway Company, is prominent among the men who are behind plans for a trolley system to connect New York and St. Louis. The scheme, it is reported, is even broader in scope than that of the great Everett-Moore syndicate, whose system is being extended to connect all of the principal cities on the Great Lakes. The Murdocks, of Lafayette, and Frank De Haas Robison, of Cleveland, are said to be associated with Mr. McGowan, and the plan is supposed to have been well developed during the recent visit of Mr. McGowan to New York.

TRANSMISSION IN ITALY.—A newspaper correspondent who visited Italy recently writes: The industries of Italy show a remarkable advance. This is largely owing to the development of electricity as a motive power. I was lately in the valley of the Nerina, where are the Marmore Falls, formed by the plunge which the River Velino takes over a precipice, 600 ft. high, into the River Nera below. Around the falls manufactories of all kinds are springing up, while down the united streams as far as Terni there are nothing but huge factories at work or in process of construction. What has taken place at Terni and in the Valnerina has taken place on a smaller scale wherever good water power for the development of electricity exists. It is proposed to light Rome from the Marmore Falls, from which it is distant 70 miles.

A COMMERCIAL CABLE DINNER.—So great a success was the first dinner of the New York staff of the Commercial Cable Company, which took place on Dec. 28, at the Pierrepont Assembly Rooms, Brooklyn, that a motion to make it an annual custom was carried by acclamation. Nearly 100 persons attended, and Mr. John Shea was chairman. Among those present were G. G. Ward, vice-president of the company; George Clapperton, traffic manager; J. H. Smart, superintendent; C. E. Merritt, assistant treasurer; Charles Cuttriss, electrician; S. F. Austin, assistant superintendent; F. H. Dennis, superintendent of the clearing house; Albert Beck, secretary, and W. G. Wenman and T. E. Hurdus, supervisors. John W. Mackay, president, sent a congratulatory message from California. Musical and dramatic selections were contributed by the "talent" of the company.

LIVERPOOL ELEVATED DISASTER.—An accident of serious nature occurred on Dec. 23 on the Liverpool elevated electric road. A dispatch from Liverpool of Dec. 24 says: Six bodies have been recovered from the Dingle Station tunnel. These apparently represent the total number of deaths resulting from the burning of the electric train yesterday on the overhead railroad. An explosion in a fuse box set fire to a train on the electric railway at Dingle Station, Liverpool, last evening, and the burning train entered a tunnel containing stacks of creosoted railroad sleepers. These were also set on fire, and the tunnel became a blazing furnace. It was at first reported that many lives were lost, but it was subsequently ascertained that many of the passengers had got out at the preceding station, and the others had escaped by jumping from the train, or were dragged out by their fellow passengers. The persons who perished were all employes.

ELECTROLYTIC INTERRUPTER.—A patent granted Dec. 24 to Thomas W. Topham describes an electrolytic interrupter of the Caldwell type. A glass jar is contained within a larger glass jar, the first-mentioned being submerged in a liquid. Near the bottom of the smaller glass jar are a number of equidistant holes of small caliber, and in the interior opposite each hole is a point, the several points being fixed to an inner electrode. The other electrode is on the exterior of the small jar, and consists of a rod with a sharp point located exactly opposite to one of the holes in the glass. Two or more of outer electrodes may be used. In action the liquid within the hole is vaporized, due to the heat generated by the current, and the small bubble of liquid thus formed breaks the current within the hole. As soon as the circuit is broken the source of heat is stopped and the surrounding body of cool liquid causes the bubble to be condensed and the circuit is restored by the inflow of the liquid.

NEW TYPE OF ROTARY CONVERTER.—A patent issued Dec. 24 to Raymond Rouge and George Faget, of Paris, France, describes a rotary transformer in which only the brushes revolve. A comparison may be made with the ordinary type of transformer if we imagine the armature to be stationary, the fields supplied with alternating instead of direct current, and the brushes run at synchronous speed. In the actual machine it is necessary to provide arrangements for giving a definite polarity to the direct current produced, as otherwise in starting up the polarity at a given binding post might be either plus or minus. The apparatus may be applied to the transformation of single or polyphase currents into direct current, or inversely. The specifications go into great detail as to the various kinds of windings and dispositions that may be employed, and means are described for obviating sparking at the brushes. Among the advantages of the system are that the lead of the brushes is constant, no matter what may be the load on the working circuit supplied by the transformer; and the apparatus, whether for single or polyphase current, is self-starting.

GOVERNMENT TELEGRAPHS.—Senator W. E. Mason, the chairman of the Committee on Post Office and Post Roads of the Senate, before which committee the subject will have to be argued, is going to introduce a bill providing for the purchase of the existing telegraph lines by the Government and making them an adjunct of the Post Office Department. He says that there is a well-formulated plan in administration circles to effect the purchase, and he anticipates that it will be favorably acted upon at this session of Congress. The fact that he, as chairman of the committee, has taken the matter up is indicative of a purpose to carry the plan to a successful conclusion. His bill will provide for the issuance of bonds by the Government, bearing 2 per cent interest, to an amount sufficient to purchase the stock of the two existing companies. He says that the earnings of the lines under government management, even with the reduced rates that will be charged, will be more than sufficient to meet the interest on the bonds and create a sinking fund that will enable the Government to own, practically free of charge, the lines at the end of 20 or 25 years. Postmaster General Payne has specifically denied Senator Mason's statements as to the intentions of the Government, in our pages.

BRANLY ON MARCONI'S FEAT.—In an interview printed in the Paris *Figaro,* Professor Branly expresses surprise that Marconi should have at one stroke increased the distance of wireless telegraphy from 400 kilometers to 1800 miles. Such a feat, he said, however, was entirely possible. Formerly the curvature of the earth appeared to enter as a serious obstacle, but the Marconi experiments between Antibe and Calvi had disposed of this point, since the aerial wires there used were completely masked from each other by the earth's curvature. This experiment definitely established that the waves followed the surface of the earth, and what was possible for a distance of a few hundred miles is possible for a greater distance, the only factor being the power of the apparatus. Nothing was, therefore, opposed to the success of Mr. Marconi, who is an ingenious, persevering experimenter, possessing a fertile mind—three elements which united go to make up scientific genius. Professor Branly, however, says that before arriving at a definite opinion it will be necessary to know exactly the conditions of the Newfoundland experiment, and to know if it was conducted in a rigorously scientific manner. For example, it should be definitely determined that there was no influence from submarine cables, which might be inductively affected by the transmission waves and thus have a part in transmitting the signals to the receiving station.

LONG WISCONSIN TROLLEY.—It is stated on reliable authority that there is on foot an electric railroad deal that is the most extensive ever contemplated in the State of Wisconsin, and which converges about the city of Oshkosh as a center.

BRITISH COLONIES.—It is stated that the telegraph lines in the British colonies have grown from 115,000 miles in 1889 to over 150,000 in 1899, and that the telephone lines in those colonies now aggregate more than 50,000 miles in length. The figures are those of the United States Treasury Bureau of Statistics, but it does not appear how many "colonies" are included.

YERKES' LONDON PLANS.—A cable dispatch from London of Dec. 23 says: At a meeting of the District Railway this afternoon, the chairman, R. W. Perks, announced that the electric power house to be erected by Charles T. Yerkes' syndicate would not only supply the underground railroads, but would also furnish power for the suburban services of several of the trunk lines, with which arrangements were now being made.

PAN-AMERICAN.—Some interesting figures are made public by the Pan-American officials regarding the receipts of the various concessions at the Exposition. The total amount collected by the Exposition as its share, usually 25 per cent of the gross receipts, was $1,332,109. The total of the receipts was $4,785,527.27. There were 25 concessions, whose gross receipts exceeded $51,500. Chicago did four times the business, according to the gross receipts, that Buffalo's concessions did, but Buffalo's were four times larger than those of Omaha. The electric tower elevators netted $83,212.

KELVIN AND CABLES.—The jubilee of the submarine cable, which occurred in 1901, recalls a little story of Lord Kelvin, whose inventions, the mirror galvanometer and siphon recorder, made "submarine telegraphy commercially practicable." At the time Professor Thomson, as he was then, was engaged on his deep-sea soundings work, he was one day discovered by a visitor experimenting with a long coil of wire. "What is that for?" inquired the visitor, pointing to the wire. "Making sounds," replied the professor. "Ah," said the guest jocularly, "what kind of note does it give off." "The deep C, of course," came the answer, like a shot, accompanied by the well-known twinkle in the professor's eye.

EXPOSITION AT LILLE, FRANCE.—Consul Atwell writes from Roubaix, Dec. 4, 1901: An international exposition will be held in Lille between the months of May and September, 1902. It will embrace the following classes: Instruction, works of art, liberal arts, general machinery, electricity, civil engineering, transportation, wheels, automobiles, sports, agriculture, horticulture, forestry, hunting, fishing, food stuffs, mines and metallurgy, decoration, household furniture and accessories, yarns, dress goods, clothing, varied industries, chemicals, sound economy, hygiene, colonization, material and export products, special application of alcohol as a motive force and for lighting and heating. The office of the exposition is No. 35 rue National, Lille.

N. Y. CENTRAL AND TROLLEYS.—An item from Boston says that the New York Central Railroad Company views with some apprehension the increasing number of trolley lines being built or already operating between the towns which are also served by the Boston & Albany line. Vice-President Van Etten, now in charge of the Albany system, is said to have inspected all of the electric roads along the line of the Boston & Albany with a view to meeting their competition more effectively. The Milford, Holliston & Framingham Street Railway seems to have been selected by the New York Central people as the first trolley road against which its new policy will be tried and a brisk war in rates is in progress. The trolley road's earnings have been cut about one-third as a consequence. When the through electric line from Boston to Worcester is once in operation, if the steam road does not earlier block its projects, a continuation, in severer form, of this struggle is to be anticipated. It is certain that the present fare of $1 will not be cut until the Boston & Worcester is practically completed. It is almost certain that at that time there will be a rate war between the two. The proposed fare on the electric line will not be more than 50 cents, and perhaps considerably less.

LOCATING FAULTS IN CABLES.—Two patents issued Dec. 17 to T. W. Varley relate to means and apparatus for locating faults in cables, such as are used for lighting and power work. The method consists briefly in sending into the cable a direct current, which is interrupted for a definite period. For example, the current may flow during eight seconds and then be interrupted four seconds. As illustrated, one side of a source of direct current is connected to earth, and the other side connected through a choke coil to one leg of the cable circuit, which will usually be one carrying alternating currents. In the direct-current circuit there is also a rotating circuit closer by means of which the current is allowed to pass during a definite interval and is then interrupted for a definite interval. The cable supposed to be grounded is then explored with a compass needle, which, during the time the direct current is flowing, will point in one direction on one side of the fault, and the opposite direction on the opposite side of the fault. The interruption of the current will indicate that the pointing is not due to a local field. The circuit closer has two brushes. When the brushes both rest upon one contact segment, the direct current will be shunted from the cable, thus obviating any spark at the break. By this means another path to ground is also provided for the normal charging alternating current, thus preventing any disturbance to the ground on the mains.

ELECTROLYTIC CYANIDE VAT.—An apparatus designed to act in conjunction with a cyanide solution to continuously extract values from ores, patented recently to Albert I. Irwin, of Cripple Creek, Col., comprises a series of tanks to retain the solutions and provided with conveyors for passing the ores from end to end of the series. The several tanks are similar in form, shallow, and each formed with an inclined end from which it discharges into the next in series. The first tank contains a caustic soda solution, in traversing which the ores absorb sufficient alkali to counteract their acidity and to increase the electrical conductivity of the cyanide solution in which they are subsequently immersed. The last is a filter through which the exhausted solution is drawn for regeneration and return. The intermediate tanks are electrolytic vats. In these the conveyor becomes the anode, formed of a pair of endless chains moving upon guide rods in the sides of the tank and connected by metal bars to whose lower faces are attached wooden blocks, oppositely inclined on alternate bars, and serving to stir the ores and move them from side to side of the tank. Two cathodes are used, one being a plate resting upon the bottom of the tank, and the second parallel to the first and to the anode, a similar plate supported between the upper and lower stretches of the endless belt. The novelty of the apparatus lies in the structural details, for the plan of causing the material to be dissolved to pass through the electrolyte, and even of using the anode as a conveyor, dates from the early days of the art. In the present construction one of the cathodes is so placed as to be scoured by the moving sludge—a disposition most unfavorable to complete recovery of the precious metal.

LETTERS TO THE EDITORS.

Gold Leaf Electroscope Experiments.

To the Editors of Electrical World and Engineer:

Sirs.—Some observations I recently made with a gold leaf electroscope may be of interest to your readers. The electroscope was made out of a half-gallon chemical boiling flask—round pattern—and the brass rod on which the leaf was hung, had a cap of about 1½ inches in diameter. The rod was insulated by means of a rubber cork, and the flask contained in the bottom some sulphuric acid and pumice stone.

On placing the electroscope on a window-sill and attaching to the rod below the cap a strip of tinfoil three-eighths of an inch wide and about 15 ft. long (the foil thickness was such that 7000 square inches weighed 1 lb.), some interesting effects were noticed under certain conditions.

The experiments were made from about noon until 3 P. M. on a very cold day, the sun at times shining brightly. When the wind

carried the foil out in a direction either west or east no effect was visible. When the sun was not shining brightly, whatever the direction of the foil might be, there was a like absence of effect; but when the sun was shining brightly and the foil floated out towards it —north to south—then a divergence of the leaves took place equivalent to about 50 degs., if the foil was in vibration.

With about 30 ft. of foil floating out in rapid vibrations and the conditions similar to those last mentioned, a divergence of about 120 degs. resulted.

NEW YORK, N. Y. J. STANLEY RICHMOND.

Marconi and the Scoffers.

To the Editors of Electrical World and Engineer:

Sirs.—The feat that almost every experimenter in electricity since Lindsay's time dreamed of has been accomplished not by a dreamer but by that very matter-of-fact young man, William Marconi, and his statement that he has signaled across the Atlantic Ocean without metallic conductors has produced a profound and critical impression. The world—and this means the electrical expert as well as the layman—has not been so wrought up over a scientific achievement since the announcement by Professor Röntgen of his discovery of the X-rays.

From time immemorial there have been scoffers, but in the face of the fact of what is actually known of the new art and of the inventor of the system which bears his name, it seems to me an unprofessional procedure, to say the least, for those who are supposed to be versed on the subject to question the veracity of the statement that the signal was sent and received, and it should be stamped as absurd the inference that deciphering the signal was mere guesswork. Atmospheric disturbances are easily to be determined from the electric waves of an emitter by an expert, and Marconi would be, above all others, able to differentiate between them.

Atlantic cableless telegraphy has followed the other epoch makers in electrical science, i. e., the Bell telephone, the Field oceanic cable and the Morse telegraph. Each of these suffered at the hands of the doubting Thomases, who, like the Missourian, must needs be shown. So it is with the recent test which will develop into cableless telegraphy.

Another injustice, it seems to me, is the severe criticism Marconi has received in giving to the public at large the first news direct of the results instead of the nicer, perhaps more legitimate, method of reading a paper before some society. Had he done this the experiment would have remained unchanged. His word given to all men through the medium of the press is just as good as it would be to a chosen few from whom the information would have been disseminated. The course he pursued gave us the news at least two months earlier than possible by the latter method, and again what would he have to say to a scientific society? He has read papers on his inventions as he made improvements from time to time, his system is well known, and in this instance, notwithstanding the tremendous distance involved, is there anything new to tell? Only that an increase of power was used, a supersensitive receiver and 1800 miles spanned. That is the story.

It is hinted that the announcement was made from a purely commercial standpoint. There is no doubt that the price of Marconi stock will rise on the strength of it, but Marconi is a producer, and his company installs instruments, whereas stock-jobbing concerns are not capable of the former, and have no time for the latter. The cry has been loud and long about the letter "S" being chosen as the test signal instead of some other, but I am of the opinion that Marconi not only received the much-objected letter, but, what is more than likely, a complete message as well. The opposition of the Anglo-American Telegraph Company is well known in connection with the tests, and, while Marconi naturally would wish to announce as quickly as possible the first recorded signal without cable he would, knowing the attitude of the company, desire also to avoid trouble and so left the message out of the statements given to the press. In all events, Marconi has done what he has claimed he did.

What the world calls for and admires are producers, and Marconi is one of them. The scoffers we have with us always, but it is only once in a decade we are permitted to witness such a striking innovation of evolutionary progress in electrical science as that of signaling without cables across the trackless waters of the great Atlantic.

NARBERTH, PA. A. FREDERICK COLLINS.

Efficiency Tests of Direct-Current Generators and Motors.

To the Editors of Electrical World and Engineer:

Sirs.—In an editorial in your issue of Dec. 14 on efficiency tests of direct-current generators and motors it is stated that the efficiency as found by testing two like machines simultaneously according to the Hopkinson method is more reliable than the efficiency computed from the losses. It seems quite evident to me that the reverse is the case and below are the reasons for my belief.

First.—Unless the machines can be directly coupled there is a factor of considerable uncertainty in the belt loss. In case the machine under test is a generator it is necessary to drive the combination by a separate motor, thus introducing more difficulties in the way of belt losses and efficiency of the auxiliary machines.

Second.—In order to load up the machine under test the field of the other must be weakened or strengthened according as the former is a generator or motor. This change in field strength produces a change in core and field losses and thus leads to an error in the efficiency obtained.

The first objection is the more serious one, since the belt losses are practically unknown quantities. Moreover, there is liability of error due to measuring relatively larger quantities than are involved in the stray power measurements. The C^2R losses in switches, instruments, cables, etc., must also be negligible. The error due to change in core and field losses is not great, but is by no means negligible. Usually it would not affect the result by one per cent.

However, the stray power method has some objections. The most valid one is the error made by assuming the core losses the same at full load as at no load. It seems reasonable to suppose that the iron losses should increase somewhat with the load due to magnetization by the armature. The amount of increase could be readily found by experiment with a machine provided with Ryan balancing coils, tests being made for stray power without the coils, and with the coils in so as to give a field distortion such as would result when running the machine at full load without the coils.

MADISON, WIS. A. C. KING.

Hertzography.

To the Editors of Electrical World and Engineer:

Sirs.—Considering the great part which wireless telegraphy will probably play in the near future and the cumbrous and non-distinctive nature of the term, would it not be advantageous in the outset to give it short and distinguished name? I would beg to suggest the distinct appropriateness of the term "Hertzograph," "Hertzography" and "Hertzogram." The honor due to Hertz and the peculiar fitness and brevity of these terms will appeal to electricians the world over.

GREENCASTLE, IND. EWING MCLEAN.

Deterioration of Insulated Cables.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Nov. 23d, under the heading of "Resistance of Dielectric" in the Digest, is a statement that the deterioration of the insulating quality of rubber cables is due to the chemical action between the rubber and gases produced by the alternating stress on the air. Last August, in a conversation I had with Mr. Paul Lincoln, that gentleman mentioned a case of a cable that tested at the factory 70,000 volts, retested at Niagara power house at 50,000 volts, and which broke down at 17,000 volts after two weeks' service. He attributed the result to the ozone generated, and said he intended prosecuting the experiments further. I should very much like to hear whether any of your readers could meantime throw some light on the subject.

WILKESBARRE, PA. E. W. STEVENSON.

Italian Opportunities for Electrical Work.

To the Editors of Electrical World and Engineer:

Sirs.—Of late great activity has shown itself in railroad development in Italy, mostly in extending or building of subsidiary and local lines. Quite a number of new roads—steam or electric traction —are projected. Some of these are: In the province of Emilia, a line from Ceuto to St. Giovanni; in the province Lombardy, a line to connect Milan with Moltena on the Brianza Railroad; a line be-

tween Cremona, Bongo, St. Domino; in the Venetian province, a new line from Vicenza to Noveuta, and an electric road along the Garda Lake from Peschieva towards Riva; in the province of Piedmont, the line Turin to Torre Pellice is to be changed to electric traction, and a new steam railroad is projected to connect Turin with Oneglia via Ceva and Onmeo.

The long-entertained project of connecting Mestre (Venice) with Primolano via Castelfranco and Bassano now appears to become realized. Other new short connections with the Simplon line are planned.

In this period of activity in railroad construction our great American promoters and purveyors of railroad and electrical supplies ought to have able engineers and commercial representatives in Italy. Though business is good at home the manufacturers whose capacity for production is constantly increasing, should in time secure such foreign contracts and cultivate foreign fields, or they will find themselves idle and out of pocket later on when stagnation appears in the home market or home competition makes work profitless.

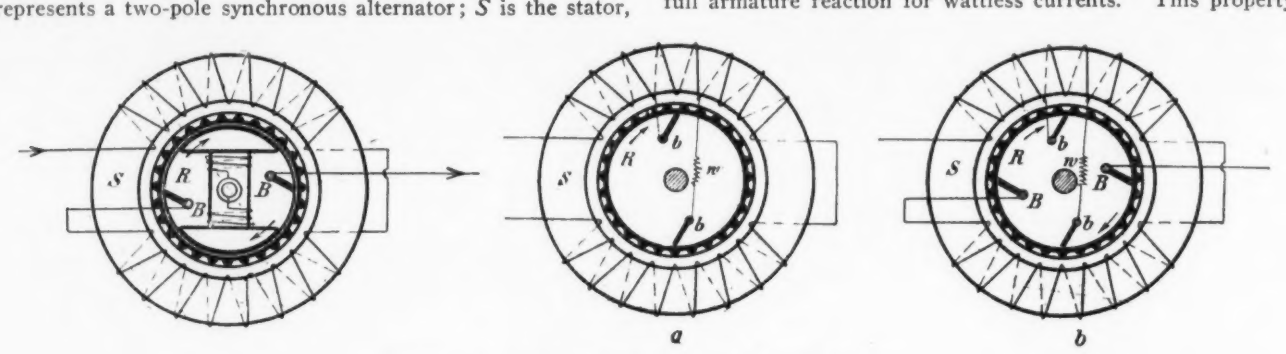
SIMON W. HANAUER.

U. S. CONSULATE, GENEVA.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compounding of Alternators.—HEYLAND.—A long and very interesting article, illustrated by diagrams, in which he points out the great advantages which may be obtained with his "non-synchronous alternator," based upon the same principle as his induction motor with power factor equal to unity (Digest, Aug. 31, Oct. 19, Nov. 30, Dec. 14, 21; also ELECTRICAL WORLD AND ENGINEER, Sept. 28, p. 492). The first part of the present article deals with the compounding of the ordinary alternator. He thinks that the compounding devices of Leblanc and of Steinmetz are ingenious, but quite complicated, as they use a converter connected with the generator, and transforming a part of the armature current of the alternators into direct current, which is used for compounding. He describes the following method of compounding an ordinary alternator ("synchronous alternator"). Fig. 1 represents a two-pole synchronous alternator; *S* is the stator, the armature, in the windings of which the alternating current is generated. *R* is the rotor with two poles, in which a constant field is generated by direct current. This pole-wheel is also provided with a winding, uniformly distributed over the surface as in the Leblanc amortisseur, this winding is, however, not completely closed in itself, but is connected with a commutator, to which current is supplied through the brushes *B B*. If these brushes are connected in series with the main winding of the stator (the armature), the conditions can be arranged in such a way that this compound winding compounds the main winding of the stator. As this winding participates in the rotation of the field, there is no induction of e. m. f.'s, and the voltage between the brushes depends only on the resistance of the winding and is very small. He gives diagrams which show that the compounding can easily be accomplished by properly arranging the ratio of the compound windings to the armature windings and the position of the brushes. In designing, it is sufficient to calculate the conditions approximately. If the armature reaction or the straying should be smaller than had been expected, the exact compounding is obtained by a shunt in parallel to the compound winding, i. e., between the brushes *B B*. A single synchronous alternator should be compounded, when it supplies current to a network, but parallel operation of several compound alternators is not possible. With two machines in parallel, a "mutual" compounding may be used. When there are several alternators supplying a network, only one or two are compounded, the others are not. When a synchronous alternator supplies current to a synchronous motor, the motor is compounded, the generator is not, or the generator is compounded, but not the motor. In this case, a partial compounding of the motor may be suitable, which is explained diagrammatically. From the foregoing it is seen that this method of compounding requires a special winding on the revolving field system. This is not necessary with the Heyland "non-synchronous alternator," which is based upon the principle of his induction motor with a power factor equal to unity. All that is required in this case is another pair of brushes, through which the rotor is supplied with current from the armature. His non-compounded, non-synchronous alternator is shown in Fig. 2, while the same machine, when compounded, is illustrated in Fig. 3. The brushes *b b* are for excitation, the brushes *B B* for compounding. He treats this generator by the graphical methods and gets the important result that "the non-synchronous generator of the described form has no armature reaction for energy currents, but full armature reaction for wattless currents." This property of the non-synchronous alternator may be called the "natural compounding for energy currents," as it occurs automatically, without the supply of a compounding current, in contrast with the artificial compounding described above. This property of the non-synchronous machine is of essential importance. On the one hand, the armature reaction for wattless currents is absolutely necessary for operation in parallel and for power transmission. On the other hand, the armature reaction for energy currents is a necessary evil of the synchronous machine which one tries to avoid by various means. Large air space, high saturation of iron, and even high excitation, are all objectionable. The armature reaction limits the overload capacity of synchronous generators. It causes the motor to lag behind the generator by a certain angle, and when this angle gets to be 90 degs. (i. e., half the angle between two poles), the synchronous machine falls out of step. For the non-synchronous motor there is no such thing like this angle of lag. The load which causes the angle of lag for the synchronous machine, causes the slip in the non-synchronous machine. But the slip is not deleterious, on the contrary it is an elastic link in the chain of the transmission of power. The result is that with non-synchronous alternators operating in parallel, the degree of non-uniformity of the prime mover during one revolution, may not be smaller than with direct-current machines. Even operation in parallel with directly connected gas engines should be possible. This exposition shows that the advantages of the described non-synchronous alternator or motor over the synchronous machine are not only inherent in the non-synchronism of the machine, but in all the mechanical and electrical properties. There seems to be practically



FIGS. 1, 2 AND 3.—COMPOUNDING OF ALTERNATORS.

no overload limit, the problem of the phase difference between current and e. m. f. finds a much better solution than is even imaginable for the synchronous machine, and the problem of the degree of non-uniformity of the prime mover may, in fact, be of no greater importance than for direct-current machines. Especially for large multipolar generators valuable practical success may be hoped for in this regard.—*Elek. Zeit.*, Dec. 12.

Periodic Variations in the Exciting Current of an Inductor Alternator.—DUDDELL and MARCHANT.—The last part of their illustrated paper. They reach the following conclusions. In any alternator in which the rotation of the moving part varies the number of lines of force threading the field coils, there is induced a periodic e. m. f. in the field coil which causes a periodic variation in the exciting current, and this effect may be considerable in the case of inductor alternators. The exciting current may be considered to consist of two parts, namely, a constant current, and a superimposed alternating current of twice the frequency of the armature e. m. f. The added alternating current is not symmetrical. The amplitude of this current is, owing to the high self-induction of the field coil, to a large extent independent of the resistance of the field circuit. When the machine is on open circuit, the maximum value of the exciting current occurs approximately at the same time that the armature e. m. f. has its greatest positive or negative value. When the machine is on open circuit, the amplitude of the exciting current wave is approximately proportional to the amplitude of the armature e. m. f. wave for constant speed. When the machine is on open circuit, the amplitude of the exciting current wave is practically independent of the speed for a constant mean exciting current. The amplitude of the superimposed alternating current in the field is reduced when the machine is loaded, and becomes very small when the machine is short-circuited. These variations in the exciting current tend to reduce the efficiency of the machine due to hysteresis and eddy current losses. The e. m. f. induced in the field coil may, under certain conditions, endanger its insulation and may produce disturbing effects in any other apparatus supplied with current coming from the same source as the field excitation, more especially if any of the apparatus behaves like a condenser.—Lond. *Elec.*, Dec. 13.

REFERENCES.

Eddy Currents in Pole Pieces.—An anonymous communication giving some mathematical notes on special points in the recent article of Picou, on the eddy currents in the pole pieces of direct-current dynamos.—*L'Ind. Elec.*, Nov. 25.

Artificial Loading of Alternating-Current Machinery.—GOLDSCHMIDT.—A translation, with illustrations, of the German article, recently abstracted in the Digest.—Lond. *Elec. Eng.*, Dec. 13.

LIGHTS AND LIGHTING.

Bang Electric Lamp.—A note on a new electric lamp constructed by the Danish physician Bang, which is likely to prove of great importance even outside of the field for which it is intended. In the ordinary arc lamp the carbons are heated to some 3000 degs. This is avoided in the new lamp by making the carbons hollow and letting a strong current of water run through them. The effect is that almost the whole of the energy of the electric current is removed to the light arc between the two electrodes, while the latter themselves remain so cool that one can touch them with one's finger while the lamp is burning. Besides, the carbons are consumed so slowly that the usual automatic adjustment can be dispensed with. "In science the new lamp will no doubt be invaluable. Its cold light is able to kill bacteria in one-eighteenth of the time required with the light of the ordinary arc lamp." The electrodes can be made from different substances, according to the use for which the lamp is intended. For medicinal purposes, carbon, silver and certain kinds of iron appear preferable.—Lond. *Eng'ing*, Dec. 13.

POWER.

Electric Driving in Sibley College.—A reprint of the report of the committee consisting of Professors Ryan, Morris and Barr, with recommendations upon the use of electric motors in the shops and laboratories of Sibley College. They recommend in all cases standard makes of slow-speed direct current, 500-volt motors, and to drive the tools in the various laboratories with individual motors. An installation of a variable speed motor drive by means of the multiple pressure system is also recommended. As there is no supply of alternating current at present available, no alternating-current motors are recommended.—*Sibley Jour. of Eng.*, Dec.

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Electrically-Driven Winding Gear.—An illustrated description of an electric winding gear, used in a British colliery for winding from a "staple" about 100 yards deep. The gear is driven by a four-pole open type motor, capable of working up to 50 efficient horse-power at a speed of about 600 r. p. m.—Lond. *Elec.*, Dec. 13.

Transmission Plant in Mexico.—An article on the generation and transmission of electrical energy by the San Ildefonso Company, which has installed two hydro-electric plants for transmitting about 3600 hp to the City of Mexico, situated about 15½ miles distant. The voltage of the three-phase currents on the transmission line is 20,000. In the City of Mexico the current is transformed for distribution to 2600 volts.—*Eng. News*, Dec. 12.

Coal Conveying Plant.—An illustrated description of the automatic coal-conveyor plant at the Edinburgh electricity works.—Lond. *Elec.*, Dec. 13.

TRACTION.

Train Resistance.—ASPINALL.—An abstract of a paper read before the Brit. Inst. of Civil Eng. on experiments carried out with a dynamometer car on an English railway. Tests were made at speeds varying between 5 and 50 miles per hour on an almost straight line, having easy grade cuts. The mean result is embodied in the formula

$$R = 2.5 + \frac{V^2}{50.8 + 0.0278\,L}$$

in which R is the resistance in pounds per ton, V the velocity of the train in miles per hour, and L the length of the train, over coach bodies, in feet.—Lond. *Elec.*, Dec. 6.

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Brighton.—An illustrated article on the Brighton Corporation electric tramway. The trolley system is used. The power house contains three generators of together 675 kw. The line has a length of 11.5 miles of single track.—Lond. *Elec.*, Dec. 6.

Electric Traction Service Without Track.—SCHIEMANN.—A translation with the illustrations, of the German article, recently abstracted in the Digest.—Lond. *Elec. Eng.*, Dec. 13.

Automobile.—DELASALLE.—The first part of a detailed and well illustrated description of the electric automobile Electricia, made by Contal.—*L'Elec.*, Nov. 30.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

British Traction and Lighting Plant.—The first part of a well illustrated description of the municipal plant of Salford. There are eight steam-driven generators. They supply current not only for the tramways, but also for the general lighting of the borough. It was, therefore, necessary to design the dynamos so that they could be run as compound-wound machines, giving 525 volts in the former case, and as shunt-wound machines giving 480 volts in the latter. The output of each dynamo is 775 kw, but each will carry an overload of 25 per cent, this bringing the capacity up to 1000 kw. For balancing the two sides of the three-wire system, three-direct current balancing rotary transformers are used, each consisting of two independent four-pole machines. The peculiarity in their construction is that both independent armatures of each set are mounted upon one and the same axle, so that only two bearings per set are required. The commutators are mounted on an extension of the core, so that either armature can be readily withdrawn from the shaft for repairs. The field magnets are compound, the shunt windings being separately excited while the series windings are connected in parallel with one another in such a way that the current in the middle wire passes through them to the two armatures. In this way the machine, which acts as generator at any particular time, has its field strengthened by the current in the middle wire, while the field of the motor is at the same time weakened. By this means a perfect balance of voltage is automatically obtained at all loads. Each balancer is capable of dealing with an out-of-balance current of 200 amperes in the middle wire. The efficiency of the balancer under full load is 80 per cent.—Lond. *Eng'ing*, Dec. 13.

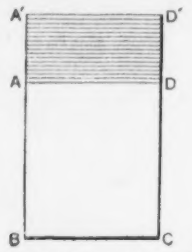
WIRES, WIRING AND CONDUITS.

REFERENCE.

Regulations.—A full account of the regulations for wiring in electric installations, as proposed by a committee appointed by the French Government.—*L'Elec.*, Nov. 23.

Electro-Physics and Magnetism.

An Electromagnetic Anomaly.—Blondlot.—He recently showed that when a mass of air is made to move in a magnetic field at right angles to the lines of force, no electric displacement is produced in the mass of air. This fact implies another, viz., that a mass of air embodying an electric displacement does not undergo any action due to a magnetic field. The following experiment is considered: A rectangular open circuit *A B C D* (see the adjoining diagram) is



AN ELECTROMAGNETIC ANOMALY.

connected at *A* and *D* with the two armatures *A* A^1 and *D* D^1 of an air condenser, both armatures being normal to the plane of the paper and enclosed in a box of insulating material. Let this apparatus be placed in a uniform magnetic field normal to the paper, and let it be displaced along *A B*. A current will be induced in *B C*, and the Joulean heat, together with the increase of energy of the condenser, will form the equivalent of the work done by the agent, which has overcome the force, acting upon *B C*. There is no other external work, and, therefore, there is no electromagnetic action of the field upon the displacement current in the air condenser. If the principle of the equality of action and reaction is now applied, it must be concluded that a displacement current in air does not exert any magnetic action, and that, therefore, from the magnetic point of view, the charging current of the condenser is an "open current." This seems to bring Maxwell's electromagnetic theory into conflict with the law of action and reaction.—*Comptes Rendus,* Nov. 25; abstracted in Lond. *Elec.,* Dec. 13.

Induction Coil.—Lord Rayleigh.—A theoretical paper on the operation of an induction coil operating by means of a break in the primary circuit. The mathematical theory of the induction coil is given, and in the second part of the paper the action of the primary condenser is discussed. Theoretical arguments are advanced to show that the use of a condenser in the primary circuit should offer no advantage as compared with a sufficiently sudden simple break. He also describes some experiments which confirm this view and appear to show that the only use of a condenser, in conjunction with an ordinary break, is to quicken it by impeding the development of an arc, so that when a sufficient rapidity of break can be obtained by other means, the condenser is deleterious, operating, in fact, in the reverse direction, and prolonging the period of decay of the primary circuit. The first requirement of a well-designed induction coil is evidently the existence of sufficient energy at break, and this implies a considerable mass of iron, well magnetized, and not forming a circuit which is too nearly closed. The full utilization of this energy is impeded by a want of suddenness in the break, by eddy currents in the iron, and (in respect to spark-length) by the capacity in the secondary. It is to be presumed that in a well-designed coil these impediments should operate somewhat equally. It would be useless to sub-divide the iron, or to reduce the secondary capacity, below certain limits, unless at the same time the break could be made more sudden.—*Phil. Mag.,* Dec.

Length of the Break Spark in an Induction Circuit.—Beattie.—An account of a series of measurements of the length of the spark which appears on suddenly interrupting an inductive circuit. He investigated the influence of the current and of the material of the break poles upon the spark length. The results are given in diagrams exhibiting much diversity of shape, and indicating that the spark-length varies with the current in different ways for different materials, so that the material which gives the longest spark with a particular current does not necessarily give the longest spark with another current. Thus with a current of 15 amperes the spark is longest with carbon poles, shortest with platinum; but on reducing the current to 3 amperes the easily fusible metals, bismuth and lead, give the longest sparks. Perhaps the most interesting point brought out, however, is in connection with the behavior of different materials on reversal of the current. With the metals, iron, copper, tin, nickel, zinc, and with carbon, reversing the current produces no perceptible difference in the spark-length, but with lead, platinum and aluminum poles the spark-length for the larger currents is notably greater when the fixed pole is negative than when it is poistive.—*Phil. Mag.,* Dec.

Dielectric Strain.—More.—A dielectric placed in an electric field is subjected to a tension along the lines of force and a pressure at right angles to them, and it is expected that it will show an elongation in the direction of the force. Such an elongation has been found by Righi and Quincke, but it was much too large and probably not due to the dielectric stress at all. Cantone also obtained elongations, but they have been placed in doubt by the present author, who, with every precaution taken, obtained purely negative results.—*Phil. Mag.,* Nov.; abstracted in Lond. *Elec.,* Dec. 6.

Measuring Temperature with the Thermopile.—Becquerel.—The author's grandfather used the following methods for determining underground temperatures at the Natural History Museum of Paris: One terminal of an iron-copper couple was brought down to the level to be measured, the other was immersed in a bath whose temperature could be varried and accurately measured by means of the mercury thermometer; the temperature of the bath was so adjusted that the galvanometer deflection became zero; the temperature of the bath was then the same as the underground temperature to be measured. The present author uses a different method which he calls that of the sliding scale. If the junction in the laboratory is kept in ice, a galvanometer, such as that of Deprez d'Arsonval, will indicate the temperature of the other junction by its deflection, which is practically proportional to the difference of temperature. That being the case, he does not consider it necessary to keep the junction in ice. He simply leaves it at the ordinary temperature, and slides the scale of the galvanometer until the latter at its zero reading indicates the temperature of the room. On closing the circuit, the galvanometer gives directly the temperature of the other junction. A high resistance should be given to the galvanometer.—*Comptes Rendus,* Nov. 18; abstracted in Lond. *Elec.,* Dec. 6.

REFERENCE.

Cremieu's Experiments.—Poincare.—A long article on Cremieu's well-known experiments, which, if they should prove to be correct, would revolutionize our electrodynamic theory. To show this would be the case, he gives a review of the theories of Ampere, Helmholtz, Maxwell and Lorentz, and of the contradicting experiments of Rowland and Cremieu. The criticisms against Cremieu's work are also noticed, and the great importance of the problem, which is at present an open question, is pointed out.—*Rev. Gen. des Sc.,* Nov. 30.

Electro-Chemistry and Batteries.

Electrolytic Dissociation Theory.—Kahlenberg.—A long paper on "The theory of electrolytic dissociation as viewed in the light of facts recently ascertained." He gives an account of an experimental investigation made by him in co-operation with Koch and Hall. The paper is probably the strongest and ablest attack which has been made in recent years on the dissociation theory. He first gives a historical introduction and a summary of many facts from which he concludes that the dissociation theory is untenable in the case of non-aqueous solutions. His experimental investigation, however, deals with aqueous solutions, the general plan being to determine the boiling points of aqueous solutions of typical, common, chemical compounds from low to very high concentrations, in order to see how the molecular weight changes with the concentration, and at the same time to measure the electrical conductivities of such solutions at or near their boiling points. From the results of both measurements he calculates the degree of dissociation, according to the theory, and compares the values found in both ways. He also measured the conductivity at 0 deg. and made at the same time molecular weight determinations by the cryoscopic method and compared the degrees of dissociation found according to the two methods. The results of the very extended investigation is given in tables and diagrams. While in some cases the agreement between the results of the two methods is good for dilute solutions, it is poor in others, and for somewhat stronger solutions there is in general no agreement at all. There are solutions which are excellent electrical conductors, and yet the molecular weight determinations show a normal molecular weight of the dissolved substances. While in some cases the molecular weight increases with the concentration, thus according at least qualitatively with the theory, in other cases the molecular weight decreases with the increase of the concentration, finally be-

coming less than what it ought to be even on the assumption that electrolytic dissociation is complete. Again, in other cases the molecular weight at first increases with the concentration and then it diminishes as the concentration increases. And these phenomena are observed in solutions the conductivity of which steadily increases with the increase of the dilution. The principal conclusion drawn from his experiments is that there is no connection between the freezing points and boiling points of solutions on the one hand and their electrical conductivity on the other, as is claimed by Arrhenius' theory. In numerous cases not even a qualitative agreement exists. A number of agreements which have been made in favor of the dissociation theory are briefly discussed. Special stress is laid on the fact that "the attempts to harmonize the theory of electrolytic dissociation with the law of mass action, have signally failed in the case of the electrolysis par excellence" (Ostwald's law for the relation between conduction and dilution). The Thomson-Nernst rule for the relation between the dissociating power of a solvent, and the dielectric constant, is shown to be not generally correct. The dissociation theory is thought to be at present at its best in explaining the phenomena of actual electrolyis. But he claims that there are important phenomena of electrolysis which the theory does not explain satisfactorily. He says that in pressing the analogy between gases and solutions, it has often been forgotten that this is after all simply an analogy. The principal difficulty of the present theory of solution is said to be, that it neglects the all-important role of the solvent and that it fails to emphasize the fact that the process of solution takes place because of a mutual attraction between solvent and dissolved substance, and that this mutual attraction which is a function of the chemical nature of both solvent and dissolved substance, is the essence of the so-called osmotic pressure. "The dissociation theory has done much good in stimulating research in many lines. It has been fruitful in proportion to the amount of truth contained in it. Like other theories founded upon too narrow a basis of induction, it has gradually been outgrown—the facts are too much for it." The problem of solutions is pre-eminently one for the chemist and should begin with the most concentrated solutions. The behavior of the most dilute solutions will then appear as a limiting case, and then the present theory of solutions will be seen in its true relation to the facts.—*Jour. Phys. Chem.*, June; *Bull. Univ. of Wis.*, No. 47; *Science Series*, No. 5, p. 297.

Discharge Potentials of Ions.—COEHN.—An abstract of a paper read before the Association of German Naturalists and Physicians. The discharge potential of metallic ions can be diminished when the metal which is being discharged, forms an alloy with the metallic cathode. The tendency of the different metals for forming amalgams corresponds to the diminution of their discharge potential at a mercury cathode. The following series was found: Zinc, cadmium, silver, copper, iron. The discharge potential of hydrogen is diminished only at a palladium cathode, as an alloy is there formed. At other electrodes the hydrogen ion, to be discharged, requires a certain survoltage for each metal, in agreement with Caspari's measurements.—*Zeit. f. Elektrochemie*, Oct. 31.

Osmotic Pressure Observation.—OKER-BLOM.—A copper ferrocyanide membrane is permeable to sodium chloride, although impermeable to copper sulphate. He finds that when dilute copper sulphate is placed on one side of such a membrane, and a concentrated sodium chloride solution on the other, the pressure on the copper sulphate side first falls, owing to water passing from it through the membrane. Sodium chloride, however, gradually permeates the membrane until the pressure due to it is the same on both side, so that an excess of pressure is produced on the copper sulphate side.—*Zeit. f. Phys. Chem.*, July 12; abstracted in *Science Abstracts*, Nov.

Electrolytic Production of Chlorates.—J. B. C KERSHAW.—An illustrated article on the manufacture of chlorate of potash by the National Electrolytic Company, which has been carried on at Niagara Falls since 1898. The cell originally used was that patented by Franchot and Gibbs, its chief distinctive feature being the use of wire gauze cathodes covered with cuprous or cupric oxide. The cell yielded a good current efficiency, but the disadvantages attending the use of copper oxides as anode material, were found in practice to more than counterbalance the gains due to higher current efficiency, and the cell now used is a modification of the original form. Its construction is described from an English patent specification. The cathode is formed by a series of vertical copper wires. The anode is lead plate, covered with platinum foil. Some statements of the patent are criticised. It is said that it has been long known that working with a rapid flow minimizes losses, due to the fact that the chlorate formed participates in the electrolysis and is again decomposed. The real difficulty is to find the point at which the highest economy is possible. Solutions containing 10 per cent chlorate of potash will chrystallize on cooling without artificial aid. Solutions containing only 3 per cent will not. Under certain conditions of manufacture it may be more paying to work with weak solutions and to adopt refrigeration. The chief feature of the cell is the use of copper wire cathodes, in place of flat cathodes of platinum or other metal. The hydrogen gas liberated at the surface of these wires quickly detaches itself, owing to their rounded surface, and there is less trouble experienced from coating of the cathode with a film or with bubbles of hydrogen than with other forms of cathode. It is questioned, however, whether the use of copper as cathode material in a cell which necessarily contains hypochlorite as intermediate product of the electrolysis is wise, and probably still more satisfactory results would be obtained, if platinum alloy were substituted as cathode material. The original supply of the National Electrolytic Company at Niagara was 5000 amperes direct current at 175 volts. Early in 1901 the capacity and output of the works have been doubled. —Lond. *Elec.*, Dec. 13.

Calcium Carbide and Acetylene in Austria-Hungary.—A note stating that during the last year promising progress has been made in Austria-Hungary in the introduction of acetylene light. The State railways and other railway companies adopted it for their stations. Austria has five carbide plants. The aggregate power of these and others under construction being 80,000 hp. Three companies have formed a kind of trust, called the "cartell." Their carbide enjoys a good reputation and an acetylene generation of 280 liters per kilogram of carbide is guaranteed. Foreign competition is not feared in Austria, as there is a very high import duty on carbide.—Lond. *Eng'ing*, Dec. 13.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Frequency Meter.—MANZETTI.—A description of an instrument which has a moving system consisting of a copper disk and a parallelopiped of laminated iron, rigidly connected, one above the other, and suspended by a silk fiber. Each is acted upon by an independent pair of coils. The two pairs of coils are connected in parallel across the circuit with an adjustable resistance in series with one pair. The torque exerted on the iron is independent of the frequency, while that on the copper being due to Foucault currents, is a function of it. If then the two pairs of coils be so adjusted that for any given frequency the torques exerted by them are equal and opposite, there will be no deflection, but for a different value of the frequency a deflection will be produced which can be annulled by adjusting the resistance in series with one pair. The measurement of the frequency is reduced to a zero adjustment of the instrument, and a measurement of a resistance ratio. In tests made by the author the instrument proved correct within the limits of accuracy with which he was able to determine the frequency. The instrument can measure very low frequencies, but its readings might be falsified by self-induction at high ones.—*Acc. Lincei Atti*, 10, p. 157; abstracted in *Science Abstracts*, Nov.

Deformation of Alternating Current Curves.—WEBER.—An illustrated description of a new apparatus for exhibiting the deformations of the curves of alternating-current waves. It consists of a kind of combined telephone and sensitive flame apparatus. A polarized electromagnet is made of a steel magnet 25 cm. long, and a straight electromagnet in such a way that the wire of the latter overlaps the former, with the two axes coinciding. Facing the core of the electromagnet is a box, such as used by Koenig in his experiments on sound. The membrane which closes the box is provided with a small armature of soft iron, and the outer surface of the box is provided with the usual gas jet. An alternating current passing through the electromagnet produces vibrations of the armature and membrane, and makes the flame sing. The singing flame can be photographed in the ordinary manner, and the deformation of the current curve appear on the negative. He reproduces photographs obtained from currents with various capacities and inductances.—*Ann. der Physik.*, Nov. 11; abstracted in Lond. *Elec.*, Nov. 29.

REFERENCES.

Dynamometric Brakes.—GUILLAUME.—The conclusion of his illustrated article in which the dynamometric brakes of Feussner and of Rieter are described. He gives some theoretical notes on the action

of dynamometric and electromagnetic brakes. He notes that they can be used as hysteresis meters and describes the use of a Pasqualini brake for testing a dynamo.—*L'Eclairage Elec.*, Nov. 23.

Calorimetry.—Hubbard.—A second article on this subject, the present one treating of the use of the separator calorimeter.—*Am. Elec.*, Dec.

Telegraphy. Telephony and Signals.

London.—The first part of a well illustrated description of the central exchange of the London Post Office telephones. The main features of the new service are: The adoption of the Western Electric common battery system; the use of underground conductors; provision for a toll rate of charging and intercommunication with the truck lines to provincial towns and other exchanges.—Lond. *Elec. Rev.*, Dec. 6.

Kensington.—The first part of an illustrated description of the new Kensington (England) exchange in the National Telephone Company's metropolitan area. The exchange is equipped with a luminous signal switchboard, embodying all the most recent developments of the central battery system, and the extremely simple method of operating is identical with that of the new exchange of the post office in London, but the actual details of the exchange equipment differ from the latter, as the company, while employing the Western Electric Company's central battery switchboard and accessories, has profited by its own experience in such matters as leading-in and the wiring of the switchboard.—Lond. *Elec.*, Dec. 6.

REFERENCE.

Telephony in the United States.—A statistical article on the present conditions of the telephone industry in the United States; an illustrated description of some typical telephone exchanges; also illustrated description of new telephone apparatus and appliances made by American manufacturers.—*Elec. Rev.*, Dec. 14.

Miscellaneous.

Electric Arc Light for Treating Skin Diseases.—An illustrated article on the application in the London Hospital, of intensely actinic light to the cure of lupus and other skin diseases. The object attained is to enable the electric arc to be used within a short distance of the patient's skin. The effect is to increase the area treated and to shorten the time of application. Two different types of apparatus are described—the enclosed pattern and the open pattern.—Lond. *Elec.*, Dec. 13.

New Books.

Die Theorie des Bleiaccumulatores. Von Dr. Friedrich Dolezalek. Halle: Wilhelm Knapp. 122 pages, 30 illustrations. Price, 6 marks.

This is one of the most creditable books in the rapidly growing literature on theoretical electro-chemistry. From the first to the last page it is limited to the discussion of the one subject—the theory of the lead accumulator. But notwithstanding this apparent limitation, the book really contains much more, as there is no volume of equal size known to the reviewer which gives an equally original and thorough exposition and demonstration of apparently all the numerous methods and principles involved in modern electro-chemistry and physical chemistry. The book is indeed the work of a master. It is also of great didactic value to engineers. There are several ways of learning a language, either by studying a grammar systematically, or through practice by listening and trying to speak, or by reading a good book and learning the grammatical rules while doing so, whenever occasion is offered. It is similar in studying electro-chemistry. The reviewer has the highest respect for the thick volumes of Ostwald's and Nernst's handbooks, and thinks that as reference books they have no equal; but he has always regarded them with the same reverence as he did his voluminous Greek and Latin grammars years ago. The engineer who, in his short leisure hours, attempts to study them thoroughly, must be courageous. It is a different thing with Dolezalek's little book. The lead storage cells is a thing which interests the engineer in itself. He is more or less familiar with its practical behavior and is naturally interested in understanding its theory. By studying Dolezalek's book he is led, step by step, to the different principles of modern physical chemistry. He sees that they are not only purely scientific speculations, but they can be applied to practical problems. He sees how they are applied, and gets in this way a working knowledge of the principles which may be of great value for him in the investigation of other problems.

The first chapter deals with the chemical reaction during charge and discharge of the lead storage battery, which is assumed to be a completely reversible cell in the sense of the sulphate theory, first brought forward by Gladstone and Tribe. The equations of this theory are given, together with a detailed review of the various experimental researches of different authors, which prove that the theory really accounts for the facts in so far as the consumption and formation of the materials in the cell during charge and discharge occur strictly in accordance with the equations of the sulphate theory. The diverging theories of Darrieus and Elbs are noticed and the points are shown where they fail. On pages 8 to 10 of this chapter, Caspari's hypothesis of the over-pressure or sur-voltage (Ueberspannung) is applied to the lead accumulator. This application (made in a paper of Nernst and Dolezalek in 1900) has been severely criticized by Mr. C. J. Reed in a paper in the January, 1901, issue of the *Journal of Physical Chemistry;* his criticism seems convincing, or at least it has not yet been refuted in the current literature.

The second chapter gives the thermodynamic proof of the sulphate theory. It is shown that the e. m. f. calculated on the basis of the sulphate theory by means of Helmholtz's formula (the modified Thomson rule) is in agreement with the facts. This proof is given for various densities of the acid.

The third chapter deals with the application of Nernst's osmotic theory of galvanic cells to the lead accumulator. As is well known, this theory is based on the hypothesis of a solution tension which between a reversible electrode and the electrolyte, acts in a precisely similar way as the vapor tension does between a liquid and its vapor. There are two different osmotic theories of the lead cell, one by Leblanc and the other by Liebenow. Both agree in the assumption that the lead electrode is reversible in regard to bivalent Pb ions, but they differ regarding the peroxide plate, which is assumed by Leblanc to be reversible in regard to four-valent positive Pb ions and by Liebenow in regard to bivalent negative lead peroxide ions. Both theories lead to the same final conclusions. The equations representing these theories are given and Nernst's formula for the e. m. f. at a reversible electrode is applied to Liebenow's theory. In the reviewer's opinion both these theories are certainly ingenious, but they appear to him to be somewhat artificial, and have not yielded any result which had not been obtained before in a different and less hypothetical way. Nevertheless, the theories are good examples to show how the Nernst theory can also be applied to cases where it does not seem to be applicable at first; for here we have not simply a metal in the solution of one of its salts, as in the ordinary applications of Nernst's formula.

The fourth chapter deals with the variation of the e. m. f. with the acid concentration. A summary is given of the experimental researches on this point, which is followed by a very interesting and ingenious thermodynamic calculation. Two storage batteries filled with acid of different densities are connected in series, but one against the other. The combination of these two cells is a source of electrical energy. The total result of the discharge is the transport of sulphuric acid from the more concentrated solution to the less concentrated solution, and of water from the latter to the former. The e. m. f. of the combination of the two cells is directly proportoinal to the change of the free energy in the system, which can be calculated in two different ways—either from the heat-toning of the transport of acid and water and from the temperature coefficient of the e. m. f. of the combination (Helmholtz's modification of Thomson's rule) or by the process of isothermic distillation with the aid of a method formerly used by Helmholtz for an analogous calculation. The e. m. f. of the combination of the two batteries can thus also be calculated in two different ways. It evidently represents the difference of the e' m. f.'s of the two cells with different acid concentration, or in other words, the variation of the e. m. f. with the acid concentration. The agreement between these calculations and measurements is excellent. While the calculations are generally valid, they can be greatly simplified for the special case of dilute solutions. This is done, and it is also shown that the simplified formula can also be obtained from Liebenow's theory and also directly from the law of chemical mass action. This simpler formula is also examined experimentally and found to be correct.

The fifth chapter deals with the variation of the potential differences at each electrode separately, with the acid concentration. The variation of the potential difference of each separate electrode against a

normal electrode, is investigated; as a normal electrode, the hydrogen electrode is usd first, and then the mercurous sulphate electrode; but the author correctly remarks that in this way he does not get the variation of the e. m. f. at the accumulator plate alone, which is what is wanted, but he gets it in combination with the variation of the e. m. f. at the normal electrode, which is not wanted. A somewhat better insight into the variation of the e. m. f. at each accumulator plate separately is obtained by the study of certain concentration cells, which is made. Again the special case of dilute solutions is taken up and the simple formula representing the same is directly developed from Nernst's theory of concentration cells. All these investigations are experimentally examined and confirmed.

The sixth chapter deals with the temperature coefficient of the e. m. f. of the accumulator. The interesting result is brought out that the temperature coefficient is negative for dilute acid, below a concentration of 0.7 grammolecule of acid per liter. At this concentration the temperature coefficient is zero, and above it positive, first increasing to a maximum and then decreasing again slowly. The seventh chapter deals with the influence of the pressure upon the e. m. f. A simple calculation (similar to that in the fourth chapter) is given, which shows that this influence is very small, and that when 8.8 per cent acid is used, there is a decrease of the e. m. f. by 0.0012 volt for an increase of the pressure to 100 atmospheres, in agreement with measurements.

The eighth and ninth chapters are of extreme importance, as a general discussion is given there of the influences to which the characteristic forms of the charge and discharge curves are due, together with a discussion of the important question of the full reversibility of the electro-chemical action of the cell. The main question is, Why is the average voltage at charging higher by several tenths of a volt than the average voltage at discharge? It is shown that it is impossible to explain this difference of the charge and discharge voltages as being due to the voltage lost in overcoming the ohmic resistance. It is convincingly shown that this difference is due to concentration changes of the electrolyte. The electro-chemical action during charge causes an increase of the concentration in the pores of both plates. During discharge both these concentrations decrease. Now, it is a fact that the e. m. f. increases with the concentration of the acid. At the usual current densities the average e. m. f. at charging is about 0.08 volt higher than corresponds to the acid density. During discharge it is lower by about the same amount. To explain this, it is only necessary to assume that the acid concentration in the pores of the plates during charge is higher by 10 per cent than in the space between the plates, and during discharge lower by the same amount; in fact, there are here also e. m. f.'s between the differently dense parts of the electrolyte, but the author is justified in neglecting them, as they are negligible against the e. m. f.'s at the electrodes. A critical analysis of the characteristic forms of the charge and discharge curves is given. Experimental facts are summed up which show that the electro-chemical action in the lead cell is fully reversible; i. e., that the chemical process during charge is represented by exactly the same equation as that during discharge, but goes on in the opposite direction; in fact, the lower the current density the more will the difference vanish between the e. m. f. of discharge and the counter e. m. f. of charge. It is shown that while both plates participate in the concentration changes causing the difference between the two e. m. f.'s, the peroxide plate predominates. On page 68, in calculating in detail the concentration change at the peroxide electrode, it is said that the increase by two molecules of water with a simultaneous decrease of 1.19 molecule of acid, is equivalent to a decrease of acid by 1.28 molecules of acid. It is evident that this cannot be a full equivalent. If it is meant that both changes would produce the same variation of concentration, it can be correct only for a certain amount of electrolyte in the pores of the plate, hence only for a special type and size of plate. The number 1.6, which the author derives, cannot, therefore, be used for general calculations.

In the tenth chapter the processes in the cell on open circuit are discussed—recovery, self-discharge at open circuit and sulphating. The eleventh chapter deals with experimental researches on the internal resistance, the twelfth with the ampere-hour capacity; various empirical formulas for the relation between capacity and current rate are noticed and a theoretical formula is developed which is at least correct for small currents. The influence of the thickness of the active mass of the plates, of the acid concentration, and of the temperature upon the capacity, is discussed. The last chapters deal with the efficiency, the processes in the cell during formation, and with methods of measurement. The book is concluded by Lunge and Isler's table of specific gravities and concentrations of aqueous solutions of sulphuric acid.

PARALLEL TABLES OF LOGARITHMS AND SQUARES. Feet, Inches and Fractions of a Foot Expressed in Decimals of a Foot and Advancing by One-thirty-second of an Inch. By Constantine Smoley, C. E. Cleveland, Ohio: Constantine Smoley. 212 pages. Price, $3.

This is a book of tables pure and simple, containing in parallel columns the square and the logarithms of dimensions from zero to 50 ft. expressed in feet, inches and fractions of inches, advancing by steps of 1-32 of an inch each. A table of five-place logarithms of numbers is bound in with the tables as are also a few pages of explanation and practical examples. Naturally such a volume is of little value to an electrical engineer, but architects and more particularly engineers engaged in structural problems should find it a great time saver. The author sets forth in his preface the method he has devised and employed for calculating the squares. It is too long to abstract here, but most interesting. From the description of the double checking by two other methods that was applied, it would seem that in all human probability the tables are errorless.

OUTLINES OF ELECTRO-CHEMISTRY. By Harry C. Jones. New York: Electrical Review Publishing Company. 106 pages, 13 illustrations. Price, $1.50.

A more appropriate title for this book would be "Outlines of Theoretical Electro-Chemistry," as the author refers briefly only once or twice to the application of electro-chemical methods in engineering practice. Nor does the book pretend to be a systematic treatise on theoretical electro-chemistry, as it deals only with several particularly interesting and important features but treats them more or less fully. After a brief historical introduction, the author discusses in the two first chapters the laws of the osmotic pressure and the theory of electrolytic dissociation. The first explanation of the term osmotic pressure is somewhat brief and could be extended to advantage, as the idea of osmotic pressure is really difficult to grasp by the beginner. In the description of the fundamental experiment proving the existence of osmotic pressure (page 7) it should have been explained that the difference of the pressures on the two sides of a semi-permeable diaphragm, measures the partial pressure of the subtance to which the diaphragm is impermeable. The meaning of the experiment would thus become clearer. The significance of the analogy between osmotic pressure and gas pressure is well brought out by the author, as is also the line of argument which led Arrhenius to the dissociation theory.

In the third chapter the dissociation theory is applied to some interesting problems of a chemical nature. The fourth chapter gives a brief account of Faraday's law, a short review of the electrochemical theories of Davy, Berzelius and Grotthus, and a detailed and clear review of the present views of the theory of ions with reference to the process of the elctrolysis of acids, bases and salts; the "primary" decomposition of water is explained according to Leblanc; the decomposition value of an electrolyte is discussed and a few notes are given on the electrolytic separation of metals. The fifth chapter deals with the determination of the relative and absolute velocities of the ions; the sixth and seventh with the conductivity of solution; Kohlrausch's law is given; the conductivity of electrolytes is shown to be a measure of their dissociation; the dissociating power of different solvents is discussed and the relation between the degree of dissociation and dilution; at the end of this chapter an instructive review is given of the different modes by which ions are formed. The last three chapters deal with the calculation of the e. m. f. of galvanic cells, and especially Nernst's theory of solution-tension; and outline his theory of concentration cells. It would have been better perhaps if in these three chapters less mathematics had been given, but it must be conceded that the author has endeavored to bring out the physical meaning of the equations.

At some parts of the book the author seems to presuppose more knowledge than beginners generally have. On page 43, for instance, he uses the law of chemical mass action which he has not explained. On page 79 he remarks that the charge of a univalent gramion is 96,540 coulombs; where this very important number comes from, should be clearly explained in connection with Faraday's law. The author's statement of Faraday's law is too qualitative. It should be

given in a strict numerical form, as it is in such a form that it is required in practice. But, on the whole, it must be said that the author understands how to treat his subject in an interesting and clear way. His book is easy reading, it is brief and covers only the principal points. These are properties which should recommend it especially to a busy electrical engineer. The author is right when he says in the preface that an engineer must be familiar with much which apparently belongs to pure science, in order to be able to see what can be put to practical use.

ELECTRIC GAS LIGHTING. By H. S. Norrie. New York: Spon & Chamberlain. 100 pages, 57 illustrations. Price, cloth, 50 cents.

This book consists primarily of descriptions of the different electric gas lighting attachments and other apparatus used in connection therewith, such as spark coils, batteries, etc., with some very elementary theoretical disquisitions. The descriptions are clear, and altogether the book is well written. The information, though elementary, is of a practical kind, and would enable a person of reasonable intelligence, who was unfamiliar with the subject to install a system of electric gas lighting.

There are six chapters in the book, entitled, respectively, "Introductory Remarks," "Multiple Gas Lighting," "Connections and Wiring," "Primary Coils and Safety Devices," "Lighting Large Buildings," and "How to Select Batteries for Gas Lighting."

A MANUAL OF LABORATORY PHYSICS. By H. M. Tory, M. A., and F. H. Pitcher, M. Sc. New York: John Wiley & Sons. 288 pages, 63 illustrations. Price, $2.

Although there are a great number of standard works extant on the subject of laboratory physics, the book before us will prove extremely useful, and will surely hold its own among its rivals. It is written in a terse, concise manner, illustrated by simple well-drawn diagrams, and it shows a wise discretion in the amount of mathematics used in its pages.

The book is divided into five chapters, the briefest being devoted to sound, the longest to electricity. The three remaining chapters are devoted to light, heat and magnetism. References to standard works are freely given, and examples, with blanks to be filled in by the students, will prove extremely useful. This work can be heartily recommended.

PRACTICAL MARINE ENGINEERING. By William F. Durand. New York: *Marine Engineering,* Incorporated. 706 pages, illustrated. Price, $5.

The purpose of the author in the preparation of this book has been to serve operative marine engineers, especially those who have not had the advantages of higher engineering education. The work is hence, to a considerable extent, descriptive, although the greater part of it is devoted to the statement and explanation of the principles affecting the operation of marine machinery and of the problems which arise in its management, care and repair. The field covered is, therefore, the middle ground between that of the advanced textbooks used in technical schools and that of the handbooks which give information without explanation and leave the practical engineer, when his need does not fall exactly within their rules, adrift on a sea of uncertainty.

Beginning with the composition, physical properties and tests of materials of engineering, the author elaborates his subject through successive chapters upon fuels, boilers, engines and auxiliaries, the operation and management of marine machinery, valves and valve gears, the steam engine indicator, special topics and problems relating to the preceding, propulsion and powering, refrigeration and electricity on shipboard. A section giving the methods of computation in elementary problems in arithmetic, geometry, mensuration, physics and mechanics with a list of questions on the subject-matter, completes the work.

The treatment of this wide range of topics is marked by simplicity and directness, and, in not a few instances, by a fullness of information which would scarcely be expected in a work of this class. Thus, for example, the section relating to boilers is not only ample in description but gives much referring to design and to the cause and prevention of corrosion and scale. Again, under the heading of boiler and engine economy, much valuable information is given as to the economic regimen of marine machinery in service, with regard especially to evaporation, expansion, coal consumption and related problems. Under propulsion and powering the author handles topics which are unusual in text-books of a general character, such as the powering of ships, the reduction of power when towing and trial trips and their lessons.

Professor Durand's purpose in the preparation of this work has met, in its execution, a marked measure of success. He has given not only a fairly complete presentation of his subject from a practical viewpoint, but has discussed also, in clear and simple language a number of somewhat difficult problems which have been handled heretofore only by mathematical processes. The book is well printed on fair paper, the illustrations are ample and effective, but the binding is flimsy and unworthy.

BOOK NOTE.

The second edition of Steinmetz's "Alternating-Current Phenomena" has been translated into French by M. Mouzet. A French translation of the same author's "Theoretical Elements of Electrical Engineering" is now being made by M. Letheule. A French translation of Behrend's "Induction Motor" will also soon be issued.

BOOKS RECEIVED.

ELEKTRO-INGENIEUR KALENDER, 1902. By Arthur H. Hirsch and Franz Wilking. Berlin: Oscar Coblentz. 209 pages, illustrated. Price, 2.50 marks.

RECHERCHES EXPERIMENTALES SUR LES SPECTRES D'ETINCELLES. By G. A. Hemsalech. Paris: A. Hermann. 138 pages, illustrated. Price, 6 francs.

LES THEORIES ELECTRIQUES DE J. CLERK MAXWELL. By M. P. Duhem. Paris: A. Hermann. 228 pages. Price, 8 francs.

English Electric Locomotives.

We show herewith two types of English electric locomotives, both for railroad siding service and one employing a storage battery.

The locomotive shown in Fig. 1 was built by Thomas Parker, Limited, of Wolverhampton, and is similar in type to those made by the same company for the Waterloo & Baker Street underground line. It is of standard gauge, and will be employed for siding service. It has a capacity for hauling 45 tons on a grade of 1 per cent at about four or five miles per hour, and lighter loads up the same grade at speeds up to eight miles per hour. The motor can be lifted from its place for inspection or repair without resorting to the use of a crane. In the roof there is a ring fastened to one of the supports, to which a set of pulley blocks is attached, and the motor is suspended by means

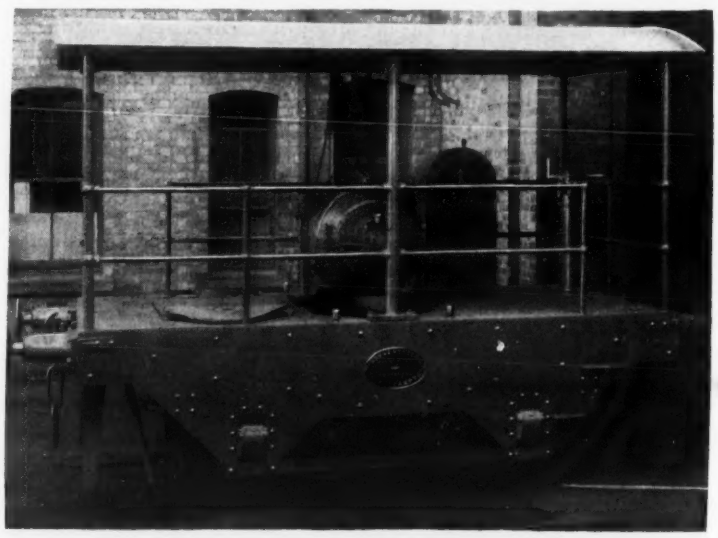


FIG. 1.—ENGLISH ELECTRIC LOCOMOTIVE.

of an eye-bolt on the top of the casing. When in its normal position the motor is below the footboard, and the whole is covered in with plates. The motor is of the four-pole, enclosed ironclad type, with carbon brushes. The armature winding is of the Eickemeyer type. The magnet yoke and the cover are cast together, with the division on the horizontal diameter. The motor develops from 40 to 50 brake horse-power when supplied with current at 200 volts. It is made both with water and dust-proof, but with lids arranged so that access may be obtained to the brushes.

The motor works through double reduction gear, with two countershafts, gearing at each end of the spindle into these countershafts, which are on the same horizontal line as the center line of the axles, so that the moving of the locomotive on the springs does not affect the teeth, which are in gear with the axle gear wheels. The controlling switches are placed in a box at one side and fastened to the hand railing. The starting, stopping, regulating and reversing switches are all operated by one handle. The brake handle is also within easy reach of the driver. The current is collected by a trolley arm, which

FIG. 2.—ENGLISH STORAGE BATTERY LOCOMOTIVE.

does not appear in our engraving. An ordinary tram car trolley base is fixed on the locomotive foot-plate, and rises through a hole in the roof. The complete weight of this locomotive is 12½ tons.

The locomotive shown in Fig. 2 was recently built at the works of Messrs. Tweedales & Smalley, of Castleton, near Manchester, to be used on their siding connected with the Lancashire & Yorkshire Railway. The locomotive is equipped with 60 Monobloc accumulators. These cells, for which Drake & Gorham, of London, are the selling agents, have a capacity of 525 ampere-hours, and are capable of charging or discharging at 105 amperes for 5 hours, 125 amperes for 3½ hours, or 390 amperes for 1 hour. It is claimed for these cells that vibration does not dislodge the active material, and that there is no buckling or breaking of the plates.

The block of the positive material is composed of punched sheets of lead, built up from the bottom of the cell, so as to form one homogeneous mass, which is cross-tied at all points to give the maximum mechanical strength. The holes punched in these horizontal sheets also form a casing and receptacle for the negative electrodes, which are in the form of vertical pencils. The positive block is formed by a special variation of the Plante process, which insures a dense and closely adherent coating that has been shown in actual practice on a large scale to resist the disintegrating effects of rapid discharges. Free circulation for the acid is provided at all points throughout the

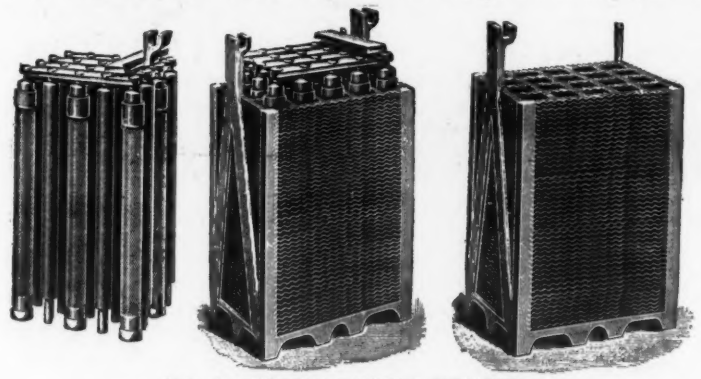


FIG. 3.—STORAGE BATTERY ELEMENTS.

cell, and the arrangement also insures the even distribution of the electric current throughout the mass, which is essential in every well-designed accumulator.

The locomotive, which is capable of drawing 120 tons, is mounted on two axles, with four wheels 43 inches in diameter. Each axle is geared to an enclosed traction motor, supplied by the Electric Construction Company, of London & Wolverhampton, and geared to the axle by double-reduction, machine-cut spin gear, having a total ratio of 20 to 1. Each motor gives a horizontal effort at the tread of the wheels of 2500 lbs. The motors also give 1000 lbs. horizontal effort at from 3 to 4 miles per hour, with 68 amperes and 120 volts. They are specially designed to operate in conjunction with storage batteries.

The controller is of the series-parallel type, effecting these combinations on the motors, and not by manipulation of the battery. The locomotive is complete with instruments for registering charge and discharge of the battery, and controlling the locomotive from either end for shunting operations. The total weight, in running order, is 22 tons. At trials recently conducted, the locomotive started with ease under the maximum load required, and under perfect control. In shifting operations in connection with freight yards there is doubtless a considerable field for the electric locomotive, for not only is the risk of fire among timber and other inflammable goods avoided, but actual economy should result from the fact that the ordinary locomotive has to be kept under steam for many hours in order to be available for comparatively short periods of use. Apart from this, the labor required for the manipulation of an electric locomotive is considerably less than that which has to be provided for its rival, the steam locomotive.

Electric Cranes.

The accompanying illustrations refer to a type of electric crane recently placed on the market by the Case Manufacturing Company, of Columbus, Ohio. As will be seen, the girders are of the "fish-belly type," which lends grace to the appearance and reduces to a minimum the amount of unnecessary material to be moved back and forth, thus increasing the efficiency of the bridge movement. The girders are of box-section, which alone is conducive to lateral rigidity, but in addition to this I-beams are used for top and bottom cover plates. This makes the girders most rigid and permits operation if necessary at a high rate of speed.

These girders rest on top of the end trucks, thus placing the strain on the plates and angles used in the make-up of the girders, instead of on rivets or bolts. The end trucks are constructed of two steel channels of heavy section, and these are held rigidly together by heavy bolts and are stiffened by cast iron separators and truck castings, which in turn support the axles of the truck wheels. The wheel base is considerably wider than general practice, thus not only distributing the load economically on crane runways, but also reducing to a minimum the possibility of the girders getting out of square with the crane runways. The method of fastening girders to the end trucks also tends to eliminate this possibility, the results of which are occasionally noticed in the breaking of flanges on bridge truck

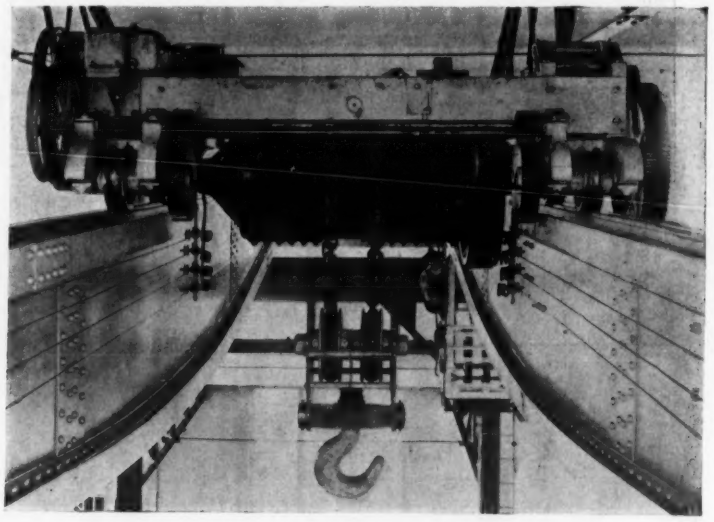


FIG. 1.—CARRIAGE OF ELECTRIC CRANE.

wheels or the necessity of frequently moving the crane to the end of the building in order to right it by running it against the buffers.

The bridge and trolley truck wheels are in all cases of cast steel. It has been found advisable to adopt this material for the reason that cast iron wheels with chilled treads are somewhat uncertain as far as the chill is concerned, this varying in thickness to such an extent that it cannot be relied upon. The flanges of these wheels are heavy enough to permit of long service before they are worn to the point where it is necessary to renew them.

The crane, as a whole, is driven by the application of power at the

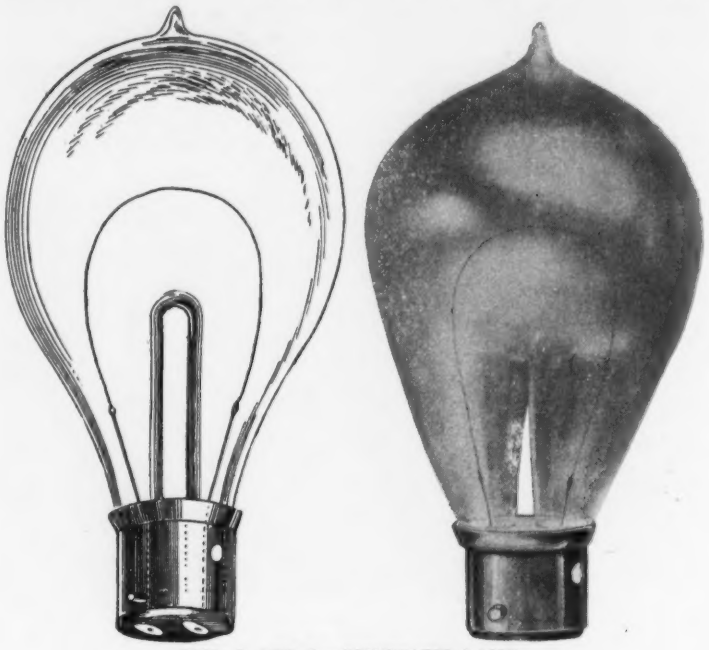
center of the bridge, and the foot brake, which is controlled in the operator's cage, is applied at the same point. This prevents torsion of the propelling shafting, and the possibility of moving one end of the crane faster, or stopping it sooner, than the other.

The chief point of interest in connection with the trolley is its short wheel base, which affords the maximum travel of the hook; or, in other words, the near approach of the hook to the runway rails at either end of crane, in this way making the crane effectively cover a large area of floor space. The construction of the trolley furthermore makes it possible to raise the hook to an unusual height with respect to the top of the runway rails. The trolley frames are cast iron box section, and bearings are equipped with removable caps, which reduces to a minimum the time required for making repairs or fitting new parts.

The pinions are made of cast steel, and the gears of a superior quality of cast iron. They are of wide face and small pitch, which tend to eliminate noise during operation, and are machine-cut from the solid, with the exception of the main drum gear and its mating pinion. These latter are shrouded to the pitch line on both sides of the teeth, which insures perfect centers and great strength.

The mechanical brake, which is very generally conceded to be one of the most important points in design and construction of a traveling crane, is different from anything heretofore in use. The principle is similar to that of several brakes now on the market in so far as the method of application is concerned. The braking power or friction is obtained, however, by a quite radically different method. Where it is desired that the crane be equipped with an auxiliary hoist, this movement is, like the main hoist, equipped with both mechanical and electrical brakes, and in no case are less than two strands of chain or cable used to the hook, which insures a vertical lift which cannot be obtained where but one strand is used.

The motors used are of the series wound, reversible type, especially designed for crane service, and operate at exceptionally slow speeds.



FIGS. 1 AND 2.—BIFURCATED LAMP.

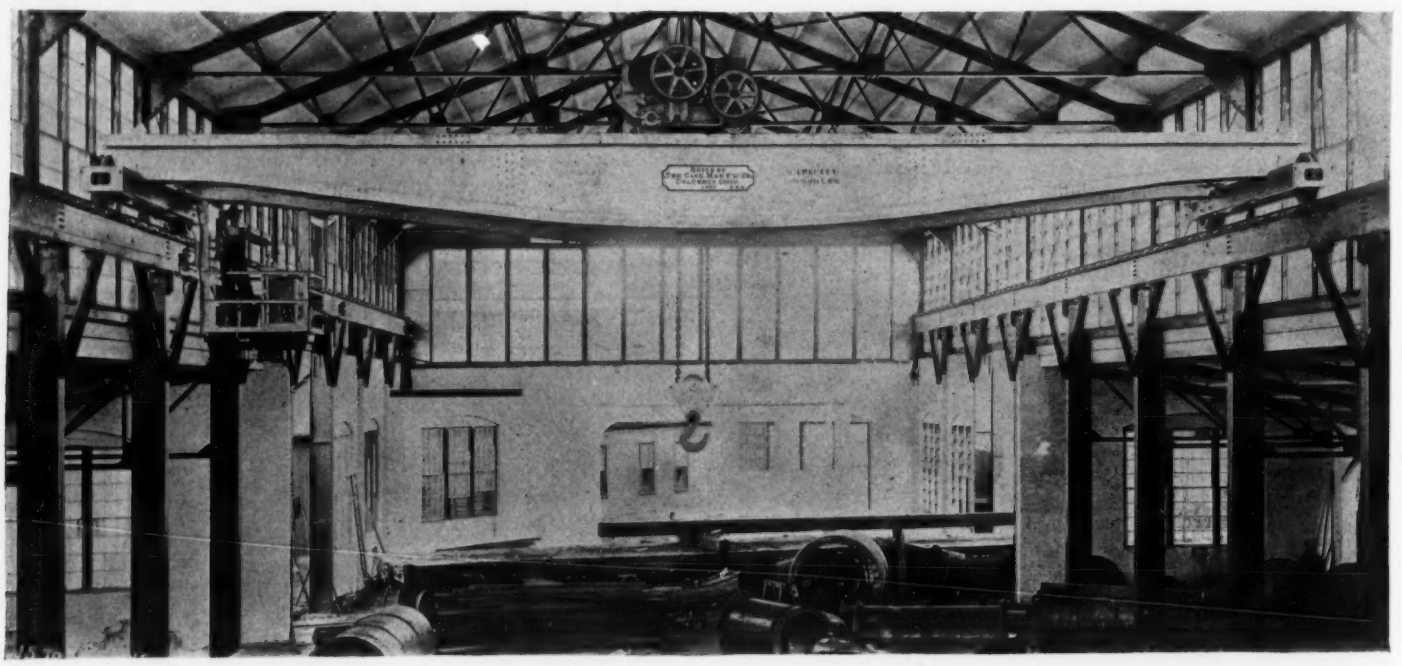


FIG. 2.—ELECTRIC CRANE.

This latter feature adds greatly to the efficiency of the crane as a whole.

Titanium Incandescent Lamp.

An interesting type of incandescent lamp has recently been brought before the electrical public in England, known as the Crawford-Voelker lamp, the inventor of which, Mr. William Lawrence Voelker, is an American citizen. Not only is an entirely new filament employed, but the bulb represents a distinct new departure.

The material of the filament is carbide of titanium, and in its preparation the electric furnace is used. The inventor claims to have discovered a method of effecting a chemical union between several of the rare earths, thereby enabling him to produce for the first time a true carbide filament. In length the filament is much shorter than the corresponding carbon filament, and it is both tough and elastic. In a report of tests made with this lamp by Col. Holden, F. R. S., superintendent of the Royal Arsenal at Woolwich, it is stated that the initial watts were 2.53 per candle, 2.84 watts at the end of 500 hours and 3.35 watts at the end of 1000 hours. Colonel Holden commends the lamp highly, and expresses the opinion that it has reached the commercial stage of development. With more recent lamps it is stated that tests have shown an economy ranging from 1.68 to 2.16 watts per cp. As compared with the high economy 3.1 carbon filament lamp, these results will be recognized as of striking significance. Another point claimed for the lamp is that there is practically no discoloration of the bulb during the life of the filament.

A filament of this material has been perfected for 500 volts, which marks a highly important advance in the art. This led to the design of a new type of bulb, which, however, has also important advantages for use with lower voltages. Various attempts have previously been made to do away with the danger of arcing or "washing" at the joints of high-voltage filaments. Edison carried out a number of experiments establishing the fact that a considerable current flows across from one joint to another of the filament and even succeeded in measuring it, but until the present it is stated that no successful means of preventing this arcing has been devised. At least 10 per cent of high-voltage filaments mounted in the ordinary

bulb are broken during the operation of pumping, owing to the current being turned on when there is still some air present in the bulb, the current thus being able to leap across from one joint to the other. This loss is stated to be entirely done away with by employing the bifurcated bulb illustrated herewith, in which the joints are separated by a double glass insulation. This involves a notable saving in manufacture, and in addition there is increased length of life of the filament due to the insulation of its joints.

In the case of high voltage lamps it is not sufficient to insulate the joints within the bulb alone, for it is important to continue this insulation in the socket itself. For this purpose the high-voltage sockets of the Crawford-Voelker lamp are made of porcelain or some suitable insulating material of that nature, with a division across into which the bifurcated end of the bulb fits and is secured with the minimum of cement necessary to obtain the requisite strength and firmness. Thus all danger of a "short" in the socket is obviated, nor can the socket absorb moisture as in the case where plaster is used. The sockets of the highest voltage lamps may, it is stated, be handled while the current is flowing through the lamp, without the slightest risk of getting a shock. As the sockets are indestructible they may be used over and over again.

Asphalt Conduits.

The accompanying illustrations show a system of asphalt conduit and troughing manufactured by the Howard Conduit Company, Limited, of Trafford Park, Manchester. Asphalt is particularly suitable for pipes or conduits, as it is impervious to water and air, resists wear and acids, is an electrical insulator and expels vermin. It is durable and easily repaired, and so ductile that it will yield to any ordinary pressure without cracking. It is unaffected by frost, and though softened by heat at about 125 degs. F. does not disintegrate even at 350 degs. F., and upon regaining its normal temperature has lost none of its desirable qualities.

Difficulties of manufacture have hitherto prevented the use of asphalt for pipes, but the Howard Company claims that it has overcome these. The process of manufacture consists in placing the hot asphalt in a sheet-iron pipe, which is revolved rapidly. Under the influence of the centrifugal force the asphalt spreads into a cylinder of uniform thickness, and is pressed into a solid mass. The heavier sediments are left on the outside of the pipe, forming a strong outer skin, and the lighter matter forms a smooth inner surface. The

FIG. I.—LAYING ASPHALT CONDUITS.

pressure developed by centrifugal force in a 3-inch pipe revolving at 300 r. p. m. amounts to 10.6 lbs. per pound of asphalt. To prevent alteration of shape there is combined with the asphalt a spiral of galvanized iron, imbedded in the material and thus protected against oxidation.

The labor in making joints is naturally very slight. A cast iron block of suitable shape is heated in a portable fire and applied between the two ends to be joined. As soon as the asphalt is sufficiently warmed the two ends are pressed together firmly and left to cool, a thoroughly welded joint being thus produced.

Asphalt troughing for use on the solid system is made on the same principle as the conduit, but without the spiral, and is pressed into rectangular shape. The cable is laid directly in the bottom of the trough without supporting clips; a small quantity of bitumen is then flowed into the trough, which is sufficient to cover the cables. The remaining space is filled with asphalt rock, which can be arched, thus forming a cover sufficient to protect the cable from external damage.

In the accompanying illustration *D* represents an iron joint box lined with asphalt, connecting two lengths of lead-covered cable *B*

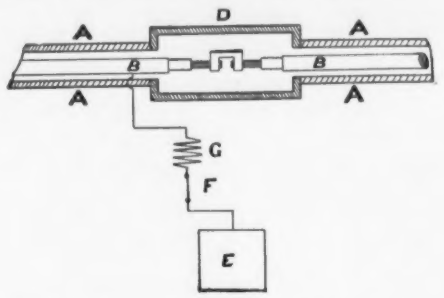


FIG. 2.—LONGITUDINAL SECTION OF CONDUIT.

laid in the asphalt trough *A*, the cable covering being connected to earth through the resistance *G* and the fuse *F*. In case of a failure of a cable causing a short circuit to the lead, and thus to the earth, the cable in the ordinary case is burned out, or the circuit breaker is opened, causing considerable trouble, especially in railway circuits. In the present system the fuse *F* in the section in which the fault occurs is blown and the lead covering is thus insulated from earth by the asphalt troughing. The cable can still be utilized until a convenient time for repairing the fault, the position of which is easily found by an inspection of the various fuse blocks. The resistance *G* is intended to prevent the flow of any electrolytic currents in sufficient strength to injure the lead.

New Fusible Switches.

A very satisfactory form of fused switch had been put on the market by the General Electric Company. It consists of a combination of the well-known punched clip spring switch with the Edison fuse plug, and is designed for 125 volts service. The use of this form of fuse has made the operation of re-fusing a switch a perfectly safe and simple matter which can be performed without tools. This feature combined with the protection which the Edison plug insures, makes this new switch desirable for use in many places where other forms

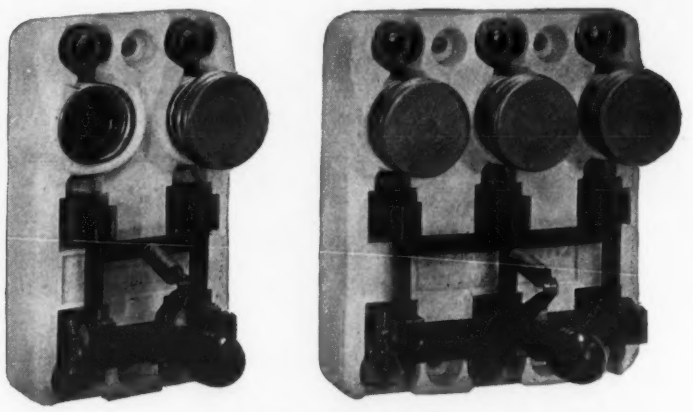


FIG. I.—FUSIBLE SWITCHES.

of switches could not well be installed. This device will be found very useful in connection with small motors, arc and incandescent lighting circuits, etc.

The parts are mounted on a porcelain base, the entire construction being substantial and proportioned for severe usage. These are made with single-throw switches, either double or triple pole. The fuse plugs can be furnished with any capacity up to and including 30 amperes.

Blow-Off Valve.

Of all boiler fittings the blow-off valve is apt to give the most trouble, and necessarily so on account of being subjected to cutting action in passing scale and sediment, and the valve being forced to its seat with grit between. To overcome as far as possible trouble from these conditions, the Lunkenheimer Company has designed a new type of blow-off valve having a self-cleaning seat, and to which the trade name of "Duro" has been given.

Referring to the illustrations herewith it will be seen that the general form of the new valve is quite similar to the iron body angle blow-off valve which has been so extensively used for some years past. Heretofore in blow-off valves the seat has been so located that as the disk approached the same there would be an accumulation of scale and sediment, the effect which has been to cut out the bearing surfaces. In the "Duro" valve the plug fits snugly in a separate and easily removable bronze casing, which can be readily replaced when worn, and any accumulation of scale on the seat is prevented by a jet of steam blowing over the same.

It will be noticed, in referring to the illustrations, that there is a steam inlet, *A*, and on the sectional cut it will be seen that this connects with an annular passage *C*. The iron body of the valve has a brass casing, *D*, with circular slot, *J*, cut into the side of same just below the level of the seat, *E*. This casing, *D*, is held in place in the valve body by the seat ring, *E*, screwing over the same, both of which are removable at any time for repairs or replacement with new parts. The opening, *A*, is connected to the steam part of the boiler and a suitable valve interposed. The object of this steam inlet, *A*, is to admit steam to *C* and *J*, and in discharging from the latter it blows across the seat, thus cleaning off any scale or sediment that may have accumulated on it, so that the disk and seat bearing when in contact will be perfectly clean.

In operation, to close the valve the disk is screwed down in the usual manner. As it approaches the level of the inlet the edge of the disk passing the lower edge of the casing, *D*, cuts off a great deal of the flow of water, sediment, etc. At this time the valve in the steam pipe leading to inlet, *A*, should be opened and the steam admitted to the annular space, *C*, from whence it passes through slot, *J*, and carries over the entire surface of the seat, *E*. In the meantime, the disk is being screwed home to the seat, which also cuts off the flow of steam from the inlet, *A*, as well as the blow-off from the boiler.

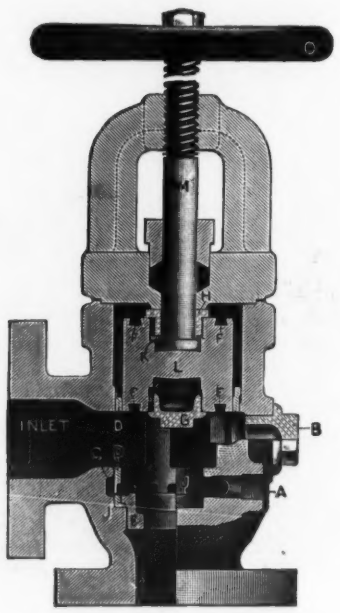


FIG. I.—BLOW-OFF VALVE.

The valve in the pipe leading to the inlet, *A*, can be left open at all times, as the disk of the blow-off valve keeps outlet closed.

It will be seen that, by the time the seating is accomplished, all scale and sediment have been blown off the seat and the surface is clean; hence there is nothing present to cut the bearing surfaces. The disk, or plug, is reversible, having two valve or seating faces, which can be changed at will, thereby increasing the durability and efficiency of the valve considerably. These valve or seating faces in the disk consist of dovetailed slots, which are filled with Babbitt metal, and, when both are cut or worn out, the old Babbitt metal can be melted out and new metal poured into the slots, which, after facing off, renews this wearing part of the valve. The seat ring, *E*, and casing, *D*, are easily removable, and, as these are interchangeable, new ones can be supplied at small cost. There is also provided a plug, *B*, opposite the inlet, so that, if desired, this can be taken off and a rod run through the blow-off pipe to clean it out.

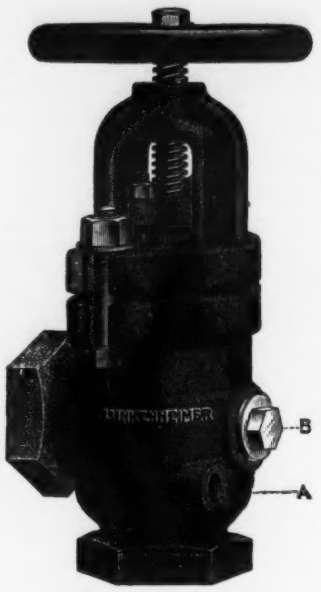


FIG. 2.—BLOW-OFF VALVE.

New International Telephone Apparatus.

The International Telephone Manufacturing Company, of Chicago, is just entering the field with a complete new line of telephone apparatus, which is especially notable for its substantial mechanical construction. While there are now no marked lines of difference, as a rule, between the telephone apparatus of the various successful companies manufacturing for the independent telephone field, there is always considerable room for improvement in details, and it is in the perfection of details that the new apparatus here described is strong.

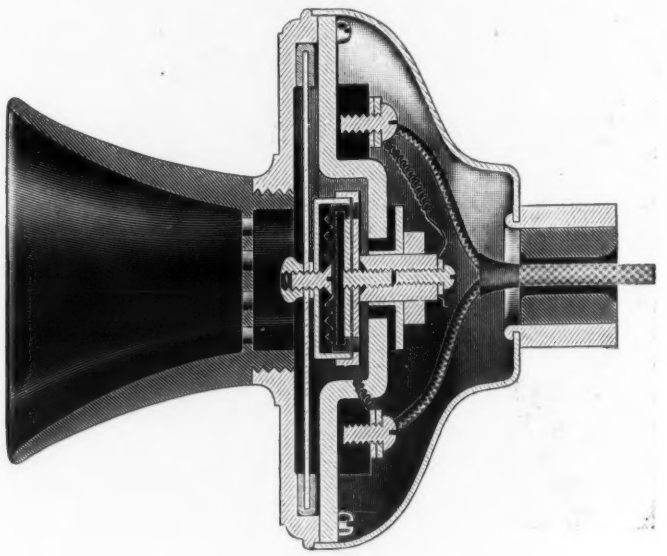


FIG. I.—INTERNATIONAL TRANSMITTER.

In the transmitter (Fig. 1) the cup, which holds the carbon, is a light metal receptacle, having its walls properly insulated and mounted on a small stud fastened securely to the center of the

diaphragm. This contains the front electrode and forms the chamber of the granular carbon. The back electrode is supported by a bridge and so mounted that it can be readily adjusted. When set in its proper position, it is firmly clamped and locked by a screw in the collar at the center of the bridge. The granular carbon is held in its chamber by a small mica ring between the back electrode and the walls of the cap to which it is clamped by a small set rim, thereby avoiding the use of felt or plush or other material which compresses in time. The diaphragm and front electrode is insulated from the frame of the transmitter.

An insulated wire leading from the front electrode is terminated at a clip on a small rubber block mounted on one end of the bridge. A similar terminal is provided on the bridge for the back electrode. From these terminals the circuit is completed to the induction coil by a double conductor cord, thus avoiding the use of the transmitter arm and frame as one side of the circuit. The bridge and all working parts of the transmitter are mounted and securely fastened

FIG. 2.—INTERNATIONAL RECEIVER.

on a strongly built cast front piece and are enclosed with a heavy stamped brass bell-shaped back piece.

The receiver, a cross section of which is shown in Fig. 2, is of the double-pole horseshoe magnet type, and is constructed so the magnets may be readily adjusted towards or from the diaphragm and so it can be conveniently locked or unlocked with a screwdriver at the set screws projecting through the side of the receiver head. The diaphragm is securely clamped to the head by a brass ring. This set ring is constructed with a disk or plate suspended in its center to form a protection to the diaphragm at the hole in the receiver cap. All metal parts of the receiver are strongly built and self-contained, and are completely enclosed in a hard-rubber shell and cap. The cord enters the top of the shell and is fastened inside, leaving no metal parts exposed.

Fig. 3 shows an individual generator call, local battery, toll line telephone. The transmitter arm is provided with a false base on which it is hinged, and is fastened with a lock and key. The induction coil and all its terminals are mounted on the false base, leaving all parts readily accessible for testing when open, and when the arm is closed no screws, terminals or wires are exposed. The arm is hollow, and through it pass the two conductor cords from the transmitter. It is made with a large surface hinge on its base for lowering and raising the arm, and is held in position by a heavy nickel plated brass bolt and nut, of neat design. The magneto box is pro-

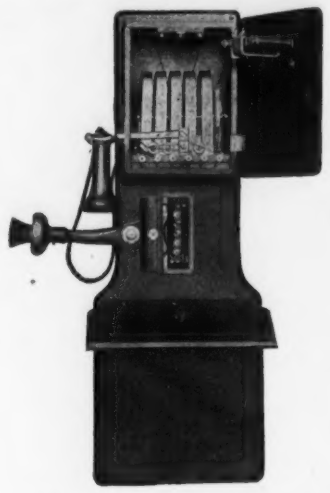


FIG. 3.—TOLL LINE TELEPHONE.

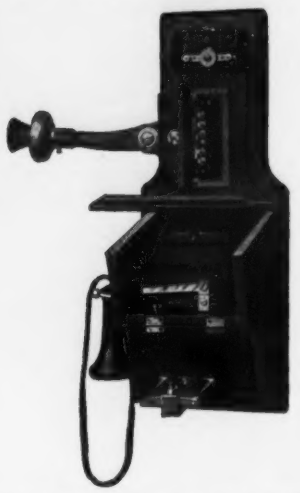


FIG. 4.—CENTRAL ENERGY TELEPHONE.

vided with a false removable bottom, on which are mounted the generator, switch and terminals. The switch is self-contained, with all springs provided with platinum points and with the hook formnig no part of the circuit. The generator crank shaft is constructed with an insulated head, perfectly insulating the crank from the generator. The polarized ringer is provided with an adjustment for the armature and also the bell hammer. The yoke to which the armature is pivoted is permanently held on one side and fastened between two adjustable thumb nuts at the other post so the armature may be readily adjusted. The bell hammer pin is fastened at the armature in a threaded stud, so the pin can be lengthened or shortened to correspond with the thickness of the board on which the ringer is mounted, so the ball may be adjusted to strike the bells properly to give the clearest tone.

The lightning arrester, a carbon disk protector with ground plate and the line terminals, is mounted at the top in the inside of the magneto box. The insulated line wires pass through the top of the magneto box and terminate at the line posts inside. In this telephone, as well as all of the company's wall and desk instruments for both generator call and central energy systems, there are no exposed metal parts that form any part of a circuit at any time. It is said that this feature has never before been so fully carried out.

Fig. 4 shows the regular public exchange central energy wall instrument. The carbon disk lightning arrester and line terminals

FIG. 5.—DESK TELEPHONE.

are mounted in a neat box at the top, which also serves as a holder for a card of directions and telephone number. The switch, ringer and condenser, are mounted under the shelf. This is so that when the shelf is raised the front with the ringer turns out on a pair of hinges and brings all parts in plain view for convenient inspection and testing.

The desk telephone shown in Fig. 5 is a strongly built instrument. Its pedestal and head is of heavily nickle-plated cast brass, making

it very rigid. The platinum contact switch springs are mounted in a hard rubber head, and with the hook-restoring spring are entirely enclosed. The induction coil and all connections are mounted in the base of the instrument.

Fig. 6 shows a combined self-restoring drop and spring jack for generator call exchange switchboards. It is so constructed that the coil may be readily removed and replaced from the front of the board, being set into a socket forming a connection the same as a

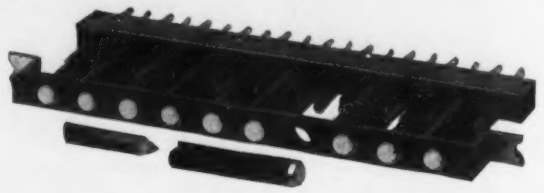


FIG. 7.—CENTRAL ENERGY LAMP SIGNALS.

plug and jack. Burned out coils can thus be removed with greatest facility. The night alarm springs are mounted on the rear of the drop and the circuit is closed when the shutter falls by a pin extending from the restoring latch. The night alarm contacts are provided with a point and plate connection, and form a slight sliding contact, making a good, reliable circuit. The drops are mounted singly from the front of the board in rows of 20.

Fig. 7 shows a bank of 10 lamp signals. The lamps are placed in an opaque tube, thus confining the light to the one signal only. An opalescence (glass) jewel is mounted at the end of the tube. The tube with lamp is inserted into the lamp jack from the front. The lamp jack is provided with a point contact to prevent corroding between the jack spring and lamp, and so the lamp may be easily removed without breaking.

Fig. 8 shows a strip of multiple springs jacks. The multiple jacks

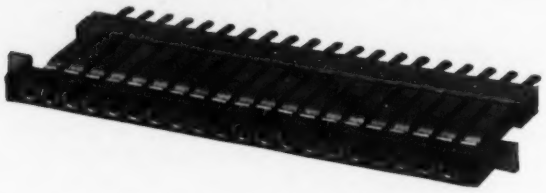


FIG. 8.—MULTIPLE SWITCHBOARD JACKS.

are mounted ⅜ inch centers (in strips of 20). The frame piece is of a veneer of a brass bar between two strips of insulating rubber, making the banks of jacks very strong and rigid. The brass bar is extended and forms a shoulder for fastening the banks to the iron switchboard frame. The springs are mounted flat upon a heavy rubber back piece, and are firmly clamped with the heavy rubber insulating bar between the tip and sleeve springs of each jack. The answering jacks for multiple boards and jacks for transfer switchboards are mounted in a similar manner with 10 on a strip.

The ringing and listening key, shown in Fig. 9, is constructed with one set of springs above the other, enabling the use of long springs and leaving the key short and compact. The cam lever is forked with one leg reaching to the first set of springs and arranged that the springs are opened from the front and with the other leg pass-

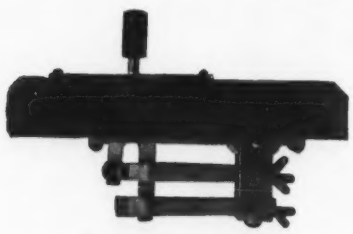


FIG. 9.—RINGING AND LISTENING KEY.

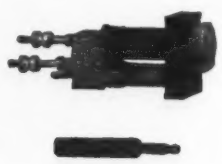


FIG. 6.—SELF-RESTORING DROP.

ing through to the second set of springs, which are so arranged that they are opened from the rear. The springs are of the best quality spring German silver, and are provided with platinum contact. The terminals of the springs are all at one end of the key, so it requires but one key cable in its wiring. The springs are mounted in a rubber block and firmly clamped to always hold them in their proper position. The block is securely fastened to a brass base for mounting.

Electric Motor Controlling Devices.

A peculiar and indispensable feature of the art of transmitting power by means of electric motors is the absolute necessity of providing a device which shall constitute the connecting link between the electric motor and the particular machine which this motor is to drive. These connecting links, known as motor-controlling devices, are, as might be expected from the wide use of the electric motor, an important article of manufacture. A large line of such devices is produced by the Cutler-Hammer Manufacturing Company, of Milwaukee, the manufacture of which. indeed, constitutes its entire business. Below we give a brief account of the more interesting of the devices made by this company.

Broadly speaking, every direct-current motor must be provided with a device for gradually admitting current to the motor and thus smoothly accelerating its speed. In order to effectually protect the motor from abnormal currents it is necessary to so arrange the starting device that it will automatically open the motor circuit on failure of the current supply. Such devices are known as automatic motor-starting boxes, and the manufacture of this appliance forms an important part of the business of this company, as may be judged from their statement that during the year just ended approximately 25,000 were produced.

These automatic motor starters range in sizes from ¼ to 50 hp of the sliding contact type, and from 50 to 500 hp using a system of interlocking switches. As indicating the diversity of requirements which arise in motor work, the following list of types is given:

A line of reversible motor starters in capacities from ½ to 30 hp are arranged to start and operate a motor at full speed in either direction, and are adapted for the handling of motor-driven machine tools, etc., where speed regulation is not required. Starters provided with an overload attachment or circuit breaker range in sizes from ¼ to 500 hp. Speed regulators for controlling the speed of motor-driven fans range from ¼ to 50 hp. Motor speed regulators for controlling the speed of motors driving machinery, which necessitate practically a constant torque or turning effort at all speeds, and require the resistance to be constructed acordingly, range in size from ¼ to 50 hp, and the same is the case with speed regulators arranged both to decrease and increase the normal speed of shunt or compound motors, these also being in sizes from ¼ to 50 hp. For automatically operating motors driving bellows for supplying air for blowing church organs, a special regulator is made. For electric elevators there are reversible controllers, operated by a cable passing through the car and ranging from 5 to 50 hp. Also, reversible controllers, operated by a small electric switch in the car and connected by means of a flexible electric cable to a number of solenoid controlled switches, which make the necessary changes in the electrical circuits, these ranging in size from 5 to 150 hp.

Another long line consists of crane controllers with sliding contacts for controlling reversible series-wound motors driving traveling cranes, jib cranes, hoists, swinging bridges, railroad turntables, etc. An important application is for small printing presses, the device being arranged to control the speed by means of armature resistance, or with the addition of shunt field regulation. For newspaper printing presses, the controllers are arranged to give maximum speed by introducing shunt field resistance, and slow printing speeds by introducing armature resistance; very slow speeds are obtained by shunting resistance around the armature terminals, with all control from one handle and means for stopping a press controlled by push buttons. Another line of controllers, with or without push-button control, is necessary for very large newspaper presses utilizing two motors connected together with gearing and a clutch. The small motor is about one-eighth the size of the larger, and drives the larger at about one-twentieth the speed of the smaller to start the press and obtain the slow feeding-in speeds.

A type of reversible drum controllers is especially designed for heavy duty in controlling traveling cranes, rolling mill machinery, etc., as well as a similar smaller reversible type for printing presses. A line of self-starters ranging from 1 to 150 hp is adapted for starting a motor automatically from a distance, and are largely used in connection with motor-driven pumps, air compressors, electric elevators, etc. Finally, there are automatic pressure regulators and float switches for use in connection with self-starting devices controlling the starting and stopping of motor-driven pumps in accordance with variations in pressure or level, respectively.

As the result of a thorough system of standardization of the vari-

ous parts which make up a complete controller, the Cutler-Hammer Company is enabled to make different combinations of standardized parts to produce the type of controller suitable for any requirements, thereby largely reducing the cost to the consumer.

Rontgen Ray Apparatus.

The accompanying illustrations show details of a Röntgen ray apparatus manufactured by Elmer G. Willyoung, which has been adopted for use in a large number of hospitals. Fig. 1 shows a hospital and office machine, which is made in sizes from 8 inches to 18 inches, inclusive. These machines are made for either battery or 110-volt circuits, and for direct or alternating currents. The same manufacturer makes a line of portable machines with extra short and very heavy cores. These portables may be run from battery or power circuits, as desired. Fig. 2 shows a Caldwell liquid interrupter, which attracted so much attention when it was invented two or three years ago. This interrupter consists essentially, it may be remembered, of a porcelain cup having a very small hole through the bottom, and a lead electrode within and one without the cup, the whole being immersed in dilute sulphuric acid. With voltages from 40 to 110 the largest coils may be run with this interrupter, the frequencies being 500 to 1000 per second, and the energy of discharge being very large.

In the illustration the curiously shaped jar is of lead, and constitutes one electrode of the combination. The radial flanges are for the purpose of increasing the radiating surface and thus keeping the apparatus cool. The same firm makes the Caldwell stereoscopic fluoroscope by means of which fluoroscopic images are seen in binocular effect. Also, the Cunningham mercury jet interrupter, which interrupter is more perfectly under control and is attracting a great deal of attention. Dr. Cunningham and the manufacturers are arranging this device to run with a synchronous motor, expecting to be able to clip off the tops of similarly directed alternating-current waves, and thus, for the first time, enable an induction coil to be satisfactorily run on such circuit.

Factory Telephones.

The accompanying illustrations show details of the intercommunicating telephone system of the Ericsson Telephone Company, 296 Broadway, New York. The Ericsson intercommunicating system is especially adapted for factory use, since it allows instant communication between any two persons without the aid of a third party.

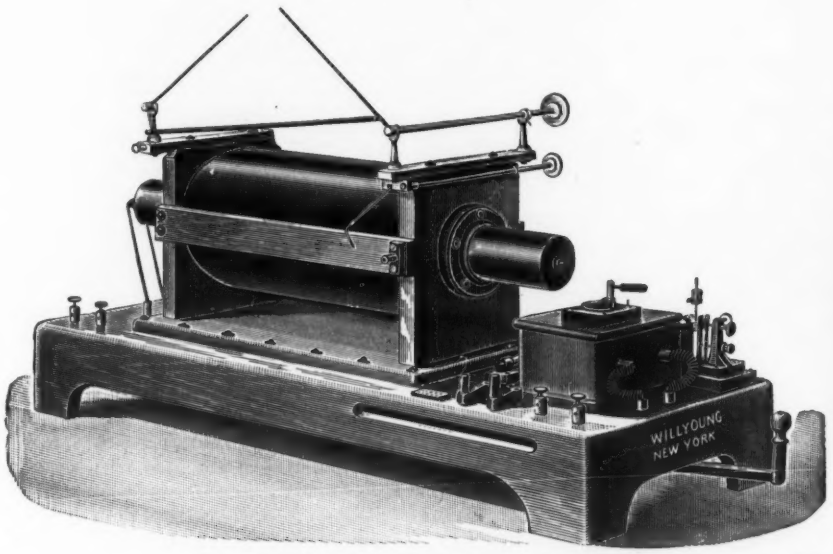
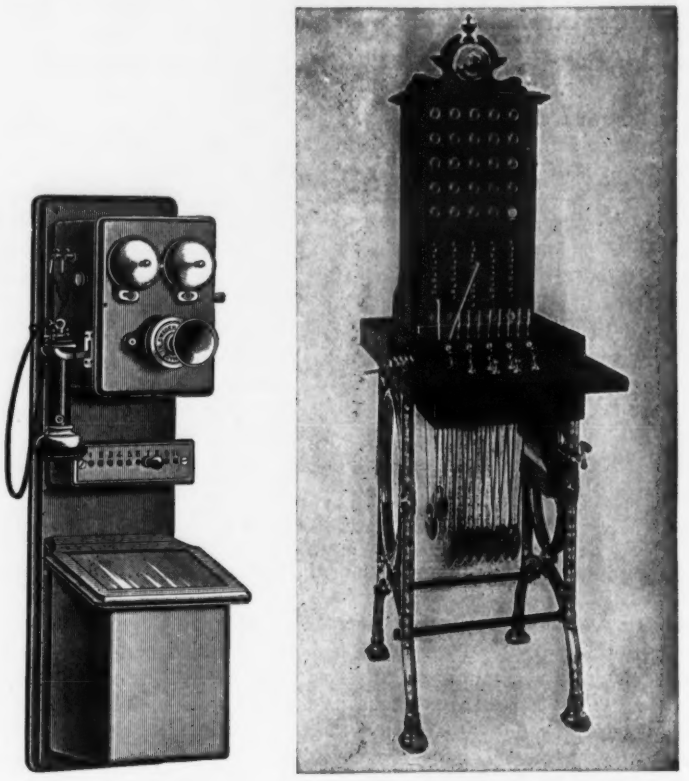


FIG. 1.—HOSPITAL AND OFFICE X-RAY MACHINE.

This system is particularly applicable where 25 or 30 stations is to be the ultimate capacity of the plant, and where the buildings do not cover too much territory. A metallic circuit switch or plug board is employed, and each station is connected to the several plug boards by twisted pairs of wires. This allows any number of pairs of persons to converse at the same time, and if proper precautions are taken when installing to avoid the effects of dampness, not the slightest interference will be noticed between the different parties. Fig. 1 shows a type of instrument used on a system of this description.

In large systems and also those that cover considerable territory, the central switchboard system is preferable, as the extra size of the cable and large quantity of wire necessary to connect the different telephones would cost a sum equal to the time of an operator for several years. This system is very similar to the one used in small local telephone exchanges, the connections between different parties being made by an operator using an ordinary switchboard. (Fig. 2.)



FIGS. 1 AND 2.—FACTORY TELEPHONE.

The central call system is sometimes desirable. This system allows the central station to call the different stations and be called by them in return, but the several stations cannot call or converse with each other. The central calling instrument is equipped with either a lever switch (Fig. 3) or a button key of proper size.

FIG. 2.—CALDWELL INTERRUPTER.

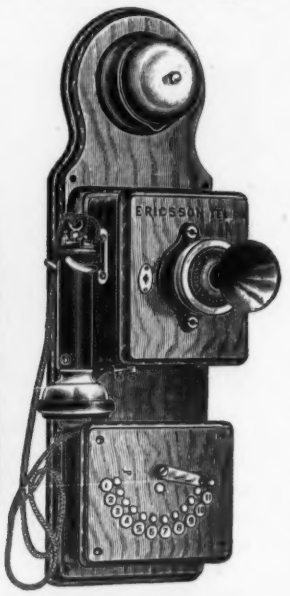


FIG. 3.—FACTORY TELEPHONE.

In many factories a bell of special design is placed near each telephone and the several bells are rung simultaneously by a button generally located in the office. By means of signals, the superintendent or manager can be notified to step to the nearest telephone and call up the office, thus saving time and trouble.

The Manufacture of Porter Storage Batteries.

The Porter Battery Company, of Chicago, has now put its factory at Waukegan in shape after the fire early in November, which destroyed a part of the building. It will have a more complete equipment than ever for turning out batteries. In this connection it is of interest to note that the Porter Battery Company is devoting all of its energy to the manufacture of automobile storage batteries, the demand for that class of battery being even greater than can be supplied, it is stated, though the output is in the neighborhood of $1,000 worth of batteries per day and 50 men are employed.

In the factory building, which is 260 by 60 ft., all different classes of work are separated into different rooms, so that there is a room for each department and a center hall running through the middle of the factory. The process of manufacture of the Porter batteries is very simple so far as construction of the plates goes. Cast grids of a lead antimony alloy are rapidly filled by hand with red lead moistened with sulphuric acid for the positive plates and litharge similarly moistened for the negative plates. This filling is done by laying the plates on a flat surface and rubbing the grooves full of active material with the aid of a putty knife. After the plates are dry they are assembled with three thicknesses of tar board between each plate and have a temporary cross connecting piece burned on with the aid of a oxy-hydrogen flame. They are then ready to put in the charging tanks. The tar board between the plates is taken out and wide rubber separators put in in its place. The separation between the plates is much greater during formation than after the cells are assembled for actual use. The forming solution has about half the quantity of sulphuric acid used in making a solution of full strength for regular use. The plates are formed at a low charging rate, and are then taken to another room for testing purposes. The defective plates are weeded out. When finally assembled for shipment the temporary cross connecting piece is taken off and a permanent one burned on in its place.

One notable thing in the policy of this company is the contract it makes for the maintenance of its batteries, which seems to be on a conservative and business-like basis. With each set of automobile batteries which it sells it is prepared to make a contract to maintain them for five years for 20 per cent of the first cost per annum. When such a contract is made the company insists on having the battery delivered at its factory or at one of its stations for overhauling and inspection every eight weeks, and, if desired, this maintenance charge will include keeping a battery through the winter. The contract for maintenance does not include damage due to accident to the vehicle nor disregard of instructions on the part of users.

The company now has a New York store, where batteries sold in that city are maintained. It has a station in the city of Chicago at the present writing, but will probably open up a more extensive store and maintenance depot the coming season. The remarkable mileage records made by a Baker vehicle with Porter batteries on one charge of battery last summer in Chicago have been noted in these columns in the past. H. C. Porter, superintendent of the company, is inclined to take the success of these batteries very modestly and gives due credit to the efficiency of the vehicle as well as to the capacity of the batteries per pound. Indeed, he has made many valuable suggestions to builders of vehicles looking toward better efficiency.

Electric Hoists.

The accompanying illustrations show several types of electric hoists made by the C. W. Hunt Company, West New Brighton, N. Y. The three essential parts of these hoists are the rope drum, the gearing and the electric motor. Each of these parts is made in a series of sizes. By a suitable combination of these parts, a hoist of any desired capacity and speed, within the limits of modern practice, may be built.

There are four factors that materially affect the size and cost of the hoist, namely, the load, the speed, the height to which the load is hoisted and the frequency of the trips. These factors affect the size, operation and cost in the following manner:

If the load is increased, the size, weight and strength of the mechanism will be increased—that is, a larger size must be used. If the velocity of hoisting is increased, the size and power of the motor will be increased, the other parts remaining the same. If the height to which the load is hoisted is increased, the drum must be increased to hold a longer rope, the motor remaining the same. If the frequency of the trips is increased, the size of the motor will be increased, the other parts remaining the same.

There are three methods of operating electric hoists: 1. Running the motor continuously, hoisting the load by throwing in a friction clutch and lowering by a band brake. This method is suitable either for alternating or direct-current motors. 2. Starting and stopping the motor for each lift, lowering by a band brake. This is better suited for direct current than alternating motors. 3. Running the motor forward to hoist and backward to lower. A direct-current motor with reversing switches is used for this work.

The mechanism of the Hunt hoist is so arranged that any size or make of motor may be used. The motor is connected to the hoist by a flexible coupling.

The great flexibility of electric transmission allows hoists to be installed to advantage in many situations where it is difficult or inexpedient to use steam-driven machinery. One of the great advantages is that the expense for power begins only when the hoist is started, and entirely ceases when the motor is stopped. The friction clutch for use on an electric hoist has far different work from one used for starting shafting, which is thrown in once or twice only each day.

The rope drums used in the Hunt Company's hoist vary in diameter from 12 inches to 60 inches. The drum barrel is sheet steel with cast iron flanges on each end. A suitable fastening is provided to secure the rope and a hole is arranged in the drum, through which the surplus rope is passed and coiled on the interior of the drum.

The necessary slipping of the friction surface generates heat that must be as rapidly dissipated or the friction surfaces would soon be destroyed. This is accomplished in these drums by making the spokes in the form of propeller blades, so that whenever the drum revolves in hoisting or lowering, they force a current of air over the heated surfaces. The part of the friction generating the heat is arranged to lie directly in the path of this current of air. A remarkable difference has been noticed in rapid work between a friction clutch with this cooling device and the ordinary arrangement.

One of the difficulties in applying electricity to hoisting machinery is the necessary reduction from the high rotative speed of the motor

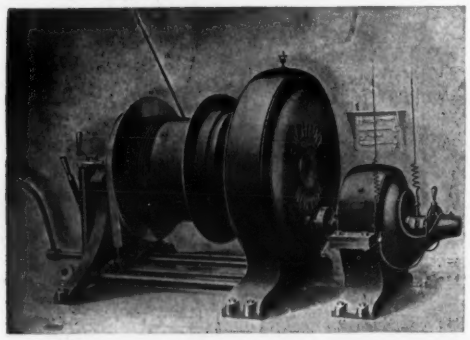


FIG. 1.—ELECTRIC HOIST.

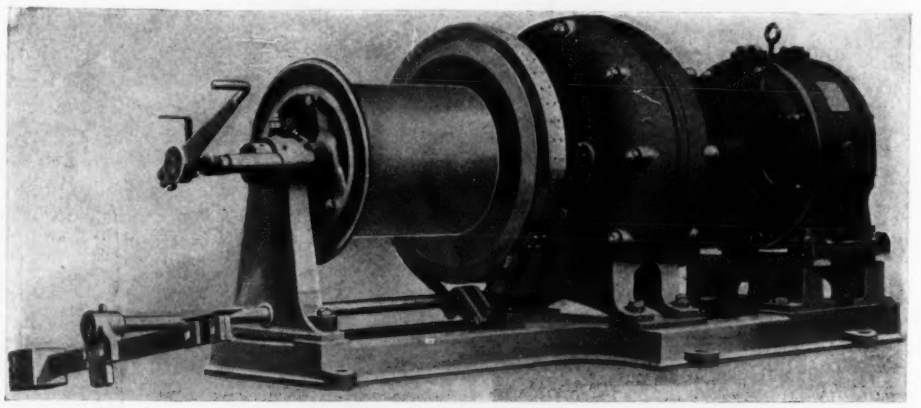


FIG. 2.—ELECTRIC COAL HOIST.

armature to the comparatively slow speed of the winding drum. With these hoists, machine cut spur tooth gears are employed. They are hydraulically pressed on shafts that are ground true on dead centers. The gears are completely enclosed in an oil-tight and dust-proof iron case, which forms a reservoir for a bath of oil in which the gears run. Powerful band brakes are applied to the end of the drum

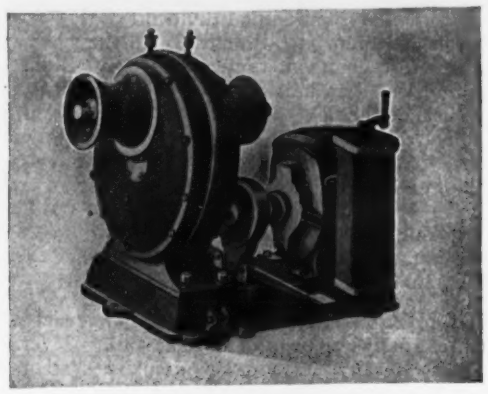


FIG. 3.—DOUBLE-SPOOL ELECTRIC WHARF WINCH.

opposite to the friction clutch so that the heat generated in one may not affect the accurate working of the other.

Improvements in Flashers.

The Reynolds Electric Company, Chicago, announce some very important improvements which they have recently made on their "Original Reyonlds Flasher," which, in reality, is a rotary jack-knife switch, having from three up to any desired number of switches working automatically as one, for giving the flashing or changeable effect to electric signs, flags and electrical displays of all kinds.

These latest improvements consist of a pin running through the spiral spring which raise the blades out of the fork contact, which acts as a guide and prevents the spring from bulging forward or to either side, making it impossible to break, and the blade cannot drop and cause short circuit or burn out. The contact forks are now made of phosphor bronze, shaped so that they are very flexible, and will take up all wear, thus insuring a perfect contact at all times. They are securely fastened to the bar which is bolted to the base, making it impossible for them to get out of alignment or for the blades to stick or the forks to burn out.

The segments are made with a groove in the center, which keeps the blade in exact line with the forks, always insuring an even and positive contact, and they are attached to the rim of the wheel with steel clamps, which prevents them from coming loose.

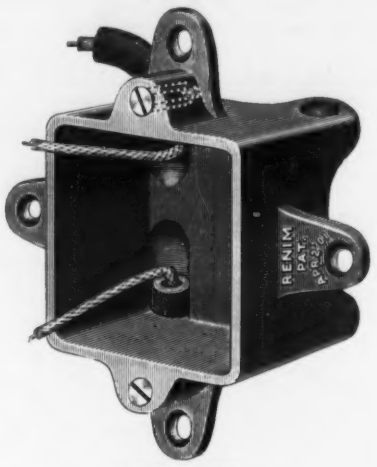
These improvements make this device a most practical, efficient and simple flasher, and should be of special interest to electric sign builders, electrical construction firms and central station people.

Universal Switch Box.

We illustrate herewith a switch box made for use in connection with porcelain knob and tube work. Ever since the introduction of flush switches, iron boxes or pockets for their installation have been furnished by the manufacturer. As the distance between the holes in the attaching ears and also the dimensions generally of the different makes of switches vary considerably, the box of one manufacturer might not fit the switch of any other. Supply houses were thus obliged to carry in stock as many different styles of switch boxes as they had makes of switches. For the same reason it was necessary for the contractor at the time of wiring, to decide on the particular make of switch he proposed to use when the job was finished possibly six months or a year later. The switch box illustrated, as the name implies, is made to take all the different makes of switches of the same style, equally well in the same box; that is, one style fitting all rotary flush switches and another style all push button switches and flush receptacles.

The adjustable feature is accomplished in a very ingenious and simple manner. The switches are attached to the box by means of long screws, the threaded portion of the screw hole being removed a considerable distance back from the front plane of the box. This arrangement allows ample adjustment in all directions and also affords a means of readily leveling the switch plate in case the switch box was not originally set plumb.

The flexible conduit enters the box by means of peculiarly constructed pockets instead of directly into the back or side of the box



SWITCH BOX.

as has been the custom heretofore. This novel method of entering securely holds the flexible conduit, at the same time allowing the boxes to be used in much thinner partitions than would otherwise be possible and also effecting a considerable saving in both labor, conduit and wire. These boxes are being placed on the market by the Renim Specialty Company, Boston, Mass.

Aerial Cable Clip.

For many years a winding of marline was considered a proper method of suspending aerial cables from the supporting strand, but its rapid deterioration and unsightly appearance has created a demand for metallic clips for supporting the cable. We illustrate herewith a recent device of this sort, known as the Metropolitan clip, and manufactured by Yonkers Specialty Company, of Yonkers, N. Y. The clip is simple in construction, consisting of a strip of zinc with a galvanized wire loop at one end and a hook at the other, and can be quickly applied to the cable in the manner shown in the cut. This is usually done by a lineman from a chair, which runs trolly-fashion along the supporting strand, the cable having previously been run out on temporary hangers.

Owing to the dangers of storm and accident to which an aerial cable is subjected, it is essential that the supporting clips be strong, that they should be securely held in place and that they should be durable. These conditions seem to have been well met in the design of the Metropolitan clip.

The standard clip has a tensile strength of about 400 lbs., which should give an ample factor of safety for ordinary sizes of cable.

CABLE CLIP.

The closed loop over the supporting wire is securely locked, and is detached with difficulty. The tendency towards longitudinal displacement which may occur on steep grades or when the cable is run out with the clips permanently in place, is corrected by studs lightly impressed upon the portion of the zinc band encircling the cable.

The manufacturers claim that this clip will last as long as the supporting strand, and it has been adopted by several of the larger telephone companies, and experience has demonstrated their practicability.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 6 per cent; time money, 6 per cent for 30 to 60 days, and 5@5½ for three, four, five and six months. In the stock market dullness and heaviness prevailed early in the week, which, however, gave way towards the end to activity and a better feeling. Amalgamated Copper had a sharp advance on more favorable views of the copper situation. United States Steel stocks closed strong on the expected favorable December quarterly earnings statement. Traction shares exhibited a firmer tone, and closed with slight net advances over the prices of the week previous. Brooklyn Rapid Transit closed at 65¼, being a net advance of ½ point, the sales being 17,830 shares. Metropolitan Street Railway sales aggregated 14,410, the closing price being 162¼, ex-div., a net gain of ⅝ point. Manhattan Elevated made a net gain of 8⅞ points, closing at 137⅞. In the electric list Westinghouse, both common and preferred, made notable gains, the former 19 points and the latter 31¾ points net, the closing prices being 177 and 187, respectively. General Electric closed at 283, a net gain of 2 points; Western Union Telegraph, 91¾, a net gain of ⅛; American District Telegraph, 36¼; American Telegraph & Cable, 95, and Commercial Cable, 170, the latter representing a net loss of 10¼ points. Following are the closing quotations of Dec. 30:

NEW YORK.

	Dec. 23.	Dec. 30.		Dec. 23.	Dec. 30.
American Tel. & Cable..	—	96*	General Electric.....	281	283¾
American Dist. Tel.....	36¼	36	General Carriage.....	1¼	1⅜
Brooklyn Rapid Transit..	64⅜	64⅝	Hudson River Tel.....	104	104
Ches. & Pot. Telephone..	66	65	Metropolitan Street Ry...	162¼	161
Commercial Cable.....	170	170	N. E. Elec. Veh. Tran..	—	—
Electric Boat.....	19	19½	N. Y. Elec. Veh. Tran...	12	12
Electric Boat pfd.....	40	40	N. Y. & N. J. Tel.....	167	167
Electric Lead Reduc'n...	1¾	1½	Tel. & Tel. Co. of Am....	—	—
Electric Vehicle.....	2¼	2¾	Western Union Tel.....	91	92⅜
Electric Vehicle pfd.....	4	4	West. E. & M. Co.....	162½	177
			West. E. & M. Co., pfd..	—	182

BOSTON.

	Dec. 23.	Dec. 30.		Dec. 23.	Dec. 30.
Am. Tel. & Tel.....	161½	164½	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone..	—	133
Edison Elec. Illum.....	250	242	Westinghouse Elec.....	80	85
Erie Telephone.....	17	15½	Westinghouse Elec. pfd..	—	90
General Electric pfd.....	—	—			

PHILADELPHIA.

	Dec. 23.	Dec. 30.		Dec. 23.	Dec. 30.
American Railways.....	43½	44½	Phila. Traction.....	97⅞	97¾
Electric Storage Battery.	61	62	Philadelphia Electric....	4⅝	4¾
Elec. Storage Batt'y pfd.	61	62	Pa. Electric Vehicle.....	¾	¾
Elec. Co. of America....	6	6⅛	Pa. Elec. Veh. pfd.....	2	2

CHICAGO.

	Dec. 23.	Dec. 30.		Dec. 23.	Dec. 30.
Central Union Telephone.	—	—	National Carbon pfd.....	83½	82½
Chicago Edison.....	160	160	Northwest Elev. com....	37	39
Chicago City Ry.....	185	185	Union Traction.....	10¼	10⅝
Chicago Telep. Co.....	223	225*	Union Traction pfd.....	47	47
National Carbon.....	19¾	19			

*Asked.

WESTINGHOUSE-GENERAL ELECTRIC.—The past week was noted by a remarkable rise in Westinghouse Electric, gains of over 30 points being shown. Inquiry did not develop any particular reason, other than the large amount of profitable business being done. Then came rumors which crystallized into the following in the financial columns: "The rise of 30 points in the price of Westinghouse Electric & Manufacturing Company stock in the last few weeks is said to be due to the fact that the General Electric Company has secured a large block of the Westinghouse stock. It is not thought that any change of control is contemplated. But it is believed that the purchase will assure harmony between the two companies, and that hereafter they will work together in better understanding." With respect to this, however, Mr. Arthur Warren, who is at the head of the publication department of the Westinghouse interests, has given out the following: "So far as I am aware, there is no foundation for the report published this morning to the effect that negotiations are pending for a merging of the interests of the Westinghouse Electric and General Electric companies. Such reports are easily originated and readily believed because the majority of financial people and others interested in industrial matters look upon such an arrangement as almost inevitable. The chief obstacles in the way of such an arrangement are probably the conservative views of those in control of the Westinghouse Company as to the capitalization, management and other details."

DIVIDENDS.—The New York & New Jersey Telephone directors have declared a quarterly dividend of 1½ per cent and an extra dividend of 1 per cent, payable Jan. 15. General Electric Company has declared a regular semi-annual dividend of 3½ per cent on preferred stock, payable Jan. 31. Practically all the preferred stock has been exchanged for common, there being only 98 shares preferred outstanding and less than half a million of the debentures. Rochester Railway has declared a dividend of 1 per cent on its preferred stock, payable Dec. 20. The Central & South American Telegraph directors have declared a regular quarterly dividend of 1½ per cent, payable Jan. 8, to stock of record Dec. 26. The following semi-annual dividends have been declared: Norwich Street Railway Company, 2 per cent, payable Jan. 2; Montville Street Railway Company, 3 per cent, payable Jan. 2; New London Street Railway Company, 2½ per cent, payable Jan. 2.

EVERETT-MOORE TROUBLES.—The financial affairs of the Everett-Moore syndicate, owning or controlling several urban and interurban electric railways, and an extensive system of local and long-distance telephone lines in Ohio and Michigan, with a capitalization of $130,000,000, passed into the control of a committee of seven prominent bankers of Cleveland this week, as the result of the financial embarrassment of the syndicate, which has for some time been affected by the stringency in the money market. It is one of the largest trolley syndicates in the world, and one which is also largely interested in independent telephony. The committee now in charge is composed of Messrs. H. R. Newcomb, Myron T. Herrick, Kaufman Hays, W. G. Mather, J. F. Sullivan, Calvary Morris and E. G. Tillotson, all of whom are connected with leading banks. Acting for the Cleveland creditors—mainly banks which hold syndicate collateral—the committee has already instituted an investigation to determine the condition of the various properties. In the meantime, the Cleveland banks have granted an extension of 18 months to the syndicate, and Messrs. Everett and Moore and their associates will go ahead with their projects, under the direction of the committee, which will act in an advisory capacity.

EL PASO ELECTRIC.—There was filed in the Register's office at Newark, N. J., a deed of trust for $1,000,000 executed by the El Paso Electric Company, a New Jersey corporation, to the State Trust Company, of Boston, Mass. The deed was put on record by James B. Dill, as counsel for the El Paso Company. The deed is given as security for a mortgage of like amount, and is described as covering "underlying securities" of certain corporations subsidiary to the El Paso Company. The latter owns or controls all of the electric lighting and power plants centering in El Paso, Texas, and it is on the stocks of the companies operating these systems that the mortgage is given. That lien is held by the State Trust Company as trustee.

GEORGIA RAILWAY & ELECTRIC.—An application for charter has been filed for the incorporation of an organization to be known as the Georgia Railway and Electric Company, with a capitalization of $3,000,000. The application is for 101 years, and includes a right of franchise in all the streets and roads in Fulton County and Dekalb County on which the present companies are now operating. The charter applied for would also give the right to own and operate electric plants, furnish electric power and steam heat. The applicants are all residents of Atlanta.

MANHATTAN FIGURES.—Lee, Higginson & Co., of Boston, issue a circular on Manhattan, in which they say: Manhattan's income available for dividends in the year ended June 30, 1901, was $2,322,336, or 4.84 per cent on the $48,000,000 capital stock. If the rate of increase in the four months to Oct. 31—$318,000 in gross and $212,000 in net—be maintained during the remaining eight months, the company would earn this year about $950,000 (10 per cent) more gross and $636,000 more net.

HUDSON RIVER ELECTRIC.—A $3,000,000 mortgage on the Hudson River Electric Company to the Morton Trust Company, of New York, has been recorded in the Saratoga County Clerk's office. It is a first mortgage to secure the issue of 3000 5 per cent coupon gold bonds at $1,000 each, covering real estate, franchises, etc.

ELECTRIC VEHICLE.—A deed of trust pledging all the real estate, stocks, patents, etc., of the Electric Vehicle Company to the Morton Trust Company, in consideration of $2,500,000, has been filed at Hartford, Conn.

BELL TELEPHONE BONDS.—It is understood that Messrs. Kidder, Peabody & Co. have purchased $10,000,000 American Telephone & Telegraph 4 per cent bonds, which will probably be issued for public subscription after Jan. 1.

ERIE TELEPHONE.—Minority stockholders of the Erie Telephone Company in Lowell have held a public meeting this week to discuss the rights of Erie stockholders under the reorganization plan, and voted to consent.

RICHMOND & PETERSBURG TROLLEY.—For power houses and equipment the Richmond and Petersburg (Va.) Electric Railway has issued $1,000,000 5 per cent 30-year bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—The mercantile agencies report an extremely satisfactory condition of trade. The retail holiday trade was a record breaker, but there was seasonable quiet in the leading wholesale lines. Iron and steel maintained activity at top prices. Continued complaints of car and motive power shortage and a general hardening of speculative markets for food products are the features of advices of the week. The year closed with a cheerfulness of feeling never exceeded, even in late years, and with sober expectations of a new year as bright as any that have gone before. Railway earnings thus far reported for December show an increase of 4.5 per cent over those of 1900, and 17.6 per cent as compared with those of 1899. *Bradstreet's* says: "The year in iron and steel closes with a burst of activity. Pig iron sales for the week have not been equaled this season. The outlook is for a production of 16,000,000 tons of pig iron, of 30,000,000 tons of ore and of 12,000,000 tons of steel in 1902. In finished products the mills are crowded with business. Some foreign steel is coming in, but most of the German products are going to England at very low prices." A large Mexican rail order has been offered, but may go to Europe, as the domestic makers are unable to undertake any new deliveries for some time to come. The copper market, according to the *Engineering and Mining Journal,* is utterly demoralized and business remained at a standstill. The only reliable information that can be gathered as to values comes from abroad where, it was understood, American electrolytic copper has been sold at the parity of 12 cents. In New York transactions, however, have been few and far between, as consumers prefer to await further developments. Following are the nominal quotations: 12¼ @12¾c. for Lake, 11¾@12¼c. for electrolytic copper in cakes, wirebars and ingots; 11½@12c. in cathodes and casting copper. The business failures for the week, as compiled by *Bradstreet's,* numbered 219, against 262 the week previous and 213 the corresponding week last year. R. G. Dun & Co. compute the liabilities of the concerns failing for four weeks of December at $8,273,341, against $9,649,121 the corresponding period of last year.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Dec. 25: Antwerp—36 pkgs. material, $3,855; 2 pkgs. wire, $90. Argentine Republic—270 pkgs. material, $9,691; 3 pkgs. wire, $162. British Possessions in Africa—3 pkgs. material, $550; 40 pkgs. wire, $705. Brazil—38 pkgs. material, $997. British East Indies—38 pkgs. material, $2,747. British Australia—18 pkgs material, $867; 1000 pkgs. wire, $2,495. Brussels—6 pkgs. material, $874. British West Indies—61 pkgs. material, $2,339; 1 pkg. wire, $18. Budapest—1 pkg. material, $25. British Guiana—29 pkgs. material, $1,603. Berlin—4 pkgs. material, $1,375. Bremen—6 pkgs. material, $295. Central America—25 pkgs. material, $699; 1 pkg. machinery, $129; 2 pkgs. copper goods, $305. Copenhagen—5 pkgs. wire, $25. Chili—20 pkgs. material, $784; 3 pkgs. machinery, $210. Cuba—247 pkgs. material, $5,343; 9 pkgs. wire, $97; 18 pkgs. wire, $285. Dutch West Indies—1 pkg. material, $12. Danish West Indies—3 pkgs. material, $40. Ecuador—1 pkg. material, $128. Frankfort—9 pkgs. wire, $112. Gothenburg—1 pkg. material, $110. Glasgow—28 pkgs. material, $2,783; 7 pkgs. material, $468. Genoa—3 pkgs. material, $200. Havre —1 pkg. material, $15; 1 pkg. machinery, $45. Hayti—3 pkgs. material, $125; 36 pkgs. copper wire, $392. Hamburg—6 pkgs. machinery, $378; 88 pkgs. material, $3,275; 1 pkg. wire, $70. Peru—16 pkgs. material, $291. Hong Hong—1 pkg. material, $242. Halifax (Eng.) —1 pkg. machinery, $95. Japan—23 pkgs. material, $1,494. Leghorn —3 pkgs. material, $350. Liverpool—34 pkgs. material, $1,441. London—169 pkgs. material, $4,681; 151 pkgs. material, $8,696; 1 pkg. wire, $28. Liverpool—13 pkgs. wire, $800. Leicester—2 pkgs. wire, $220. Leeds—20 pkgs. wire, $435. Mexico—183 pkgs. material, $12,615; 6 pkgs. wire, $180; 30 pkgs. machinery, $2,023; 74 pkgs. wire, $1,005; 2 pkgs. wire, $72. Manchester—131 pkgs. machinery, $23,250. Milan—167 pkgs. material, $2,993. Market Harborough—2 pkgs. wire, $278. New Zealand—5 pkgs. wire, $96; 8 pkgs. material, $149. New Castle—11 pkgs. machinery, $1,750. Philippines—11 pkgs. wire, $255. Rotterdam—2 pkgs. material, $200. Southampton—1 pkg. machinery, $45; 4 pkgs. material, $210. Uruguay—2 pkgs. material, $70. U. S. Colombia—4 pkgs. material, $72. Venezuela—22 pkgs. material, $52.

EXPORTS OF MANUFACTURED GOODS for November, 1901, were valued at $30,154,895, as compared with a value of $32,281,487 for November, 1900, a decrease of $2,126,592. As has been the case for every one of the recent months, this decrease is more than accounted for by the decrease in the exports of copper, which was $1,039,400, and of iron and steel, which was $1,932,500, the total of these two items being $2,971,900, or $845,300 more than the net decrease in the exports of the products of manufactures. This difference, in turn, is more than made up by increases of $990,000 in the exports of refined mineral oil, and of $353,090 in the exports of cotton goods. It follows that there were decreases in many other items, of more or less importance. Probably the most significant of these is a net decrease for the month of $189,449 in the exports of agricultural implements. The principal decreases were in the shipments to Great Britain, Germany, Cuba, Australia and Africa. Our exports of agricultural implements increased to Canada and Mexico. Another decrease is $493,941 in exports of electrical appliances. The largest falling off is in the exports of these to Great Britain, which is accounted for by the establishment there of branches of American factories. The lower price of copper is a small factor in the apparent decline in value.

TELEPHONY IN PHILADELPHIA.—The Keystone Telephone Company, the rival of the Bell in Philadelphia, goes into operation with the new year. Its central office is at Second and Sansom streets. While the company's system is by no means complete, it is possible to talk with subscribers in the central section of the city. Complete connections have been made between some of the principal office buildings, notably the Bourse, Drexel and Fidelity, and Broad Street above Arch Street. The work of extending the system, which has been going forward with such haste as to cause not a few citizens to complain because of the torn-up condition of the streets, will be pushed with unabated zeal, so that hundreds of telephones will within a few months be working. The Bell telephone rates have been cut about 20 per cent. Details of the Keystone system were given in our pages last year.

THE CUTTER COMPANY, Nineteenth and Hamilton streets, Philadelphia, and 120 Liberty Street, New York City, on Jan. 1 assumed the entire management of the sales of the Keystone electrical instruments. A number of important changes and improvements have recently been made in this well-known line of instruments, whose users include some of the best engineers in the country. Under the well directed management of the Cutter Company the sales should show a very large increase during the coming year. The manufacture of the Keystone instruments and all electrical and mechanical details will, as heretofore, be under the direct management of Mr. J. Franklin Stevens. Requests for catalogues and literature and quotations should hereafter be forwarded to the Cutter Company.

STILWELL-BIERCE & SMITH-VAILE ORDERS.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, report that they recently shipped to their London agent, Mr. Frederic Nell, one pair of 30-inch cylinder gate Victor turbines on horizontal shaft on steel center discharge end. They are also getting out for him one single 27-inch cylinder gate Victor turbine on vertical shaft, one 12-inch cylinder gate Victor turbine on horizontal shaft and a pair of 27-inch cylinder gate Victor turbines on horizontal shaft. They now have about ready for dispatch a large shipment of Victor high-pressure turbines for the Ouiatchouan Pulp Company, Ouiatchouan, P. Q., Canada. The shipment will include two 1000-hp, one 500-hp and one 100-hp turbines.

BULLOCK-WAGNER FOREIGN TRADE.—On Jan. 1, 1902, the Bullock Electric Manufacturing Company, of Cincinnati, and the Wagner Electric Manufacturing Company, of St. Louis, will establish a foreign sales department with headquarters at Cincinnati. Hereafter all foreign business, except in Mexico and Canada, for the two companies will be handled by this new department, which will be under the management of Frank G. Bolles. The work of the "Advance Department," will continue under the direction of Mr. Bolles, under whose charge it has been for the past three years.

POWER EQUIPMENT FOR WINNIPEG.—Mr. T. L. Cooper, hydraulic engineer, of New York, who has been at Winnipeg, Man., inspecting the water power facilities on the Winnipeg River for Messrs. Mackenzie & Mann, has gone to New York to order a large electric plant by which electric power will be furnished to Winnipeg. The work will be installed next spring at the confluence of the Winnipeg and Whitemouth rivers, and will cost about $50,000.

THE AMERICAN BRIDGE COMPANY, of New York, has taken an order for a bridge across the Ohio River at Marietta, Ohio, made up of two 220 ft. spans, one 1380-ft. cantilever span and a viaduct approach of 645 ft. This structure is for highway and electric railway purposes.

BALL ENGINES.—The Royal Bag Manufacturing Company, of Charleston, S. C., have recently installed an electric plant. The General Electric Company furnish the generator and the Ball Engine Company, Erie, Pa., the engine.

DATA OF INDUSTRIAL COMBINATIONS.—Census statistics on industrial combinations show a total authorized capitalization of $3,607,539,200 for the 183 corporations reported May 31, 1900. The capital stock issued was $3,085,200,868. Of this total the authorized capital includes $270,127,250 in bonds, $1,259,540,900 in preferred stock, and $2,077,871,050 in common stock. The capital stock comprises $216,412,759 in bonds, $1,066,525,963 in preferred stock, and $1,802,262,146 common stock. The total value of all the products of the combinations is $1,661,295,364, and after subtracting the value of the products of the hand trades, or mechanical and neighborhood industries, which amount to $1,216,165,160, the products of the industrial combinations in 1900 is found equivalent to more than 20 per cent of the total gross products of the manufacturing industries of the country as they existed in 1890. The 183 corporations reported employed an average of 399,192 wage earners, receiving $194,534,515 in wages. Employment also was given to 24,585 salaried officials, receiving a total of $32,653,628 in salaries. Miscellaneous expenses of the combinations aggregated $151,851,077, and the total cost of material used was $1,085,083,828. The gross value of products, less the value of material purchased in partly manufactured form, gives the net or true value of products of these combinations as $1,051,981,586. This represents the increase in the value of the raw materials resulting from the various processes of manufacture. Control of 2029 plants that were active during the census year and 174 that were idle during that period were reported. The returns show an average of 11 active plants to each corporation. The statistics exclude all corporations manufacturing and distributing gas and electric light and power, as it is impossible to trace all of the latter, and they do not generally possess the same economic significance. The returns show that the iron and steel industry is at the head of the list, with a gross product of $508,626,482, which is more than double the value of the product of any other group, except food and kindred products, and represents nearly one-third of the total gross value of products of all the industrial combinations.

ELECTRICAL MINING AND SMELTING PLANT FOR MEXICO.—The Descubridora Mining & Smelting Company, of Descubridora, State of Durango, Mexico, which is controlled by American capital, has just let contracts through Albert A. Cary, consulting engineer, 95-97 Liberty Street, for the entire electrical equipment of its mining and smelting plants. The boiler equipment, consisting of two water tube boilers of 150 hp each, is to be manufactured by John L. Gill, of Philadelphia, Pa. The engines will be built by the American Ball Engine Company, whose offices are at 95-97 Liberty Street. These machines are to be non-condensing compound type, 100 lbs. steam pressure, of 200 hp each. The generator, having a capacity of 125 kw, 550 volts, direct connected, will be manufactured by the C & C Electric Company, of Garwood, N. J. Three electric hoisting equipments are to be supplied by the Lidgerwood Manufacturing Company, of Brooklyn. One machine will have a capacity of raising 4000 lbs. 300 ft. per minute, and is to be direct connected to a 50-hp motor to be furnished by the General Electric Company. The other two hoists, each capable of handling 2000 lbs 300 ft. a minute, will be operated by 25-hp G. E. motors. The Knowles branch of the International Pump Company, 120 Liberty Street, is to supply an 8 by 8 vertical triplex pumping equipment, which will be driven by a 25-hp motor of C & C type. The Connellsville (Pa.) Blower Company is to furnish a large blowing outfit for the smelting plant, which will be operated by a 100-hp motor. The storehouse and office building will be installed with 12 enclosed arc lamps. The light will be generated by a 6-kw, 110-volt machine. All above-mentioned equipment is to be shipped by Feb. 1. The plant, it is stated, will be considerably enlarged in the near future.

C & C DOMESTIC ORDERS.—Domestic contracts recently allotted to the C & C people call for a 75-kw generator for switchboard, and an engine to be built by the Ames Iron Works, of Oswego, N. Y., for installation for general power purposes in the Scranton, Pa., shops of the Allis-Chalmers Company. The *Daily News* office, Tacoma, Washington, is to be shipped a complete 30-hp series-parallel equipment to be utilized for driving a quadruple press to be manufactured by R. Hoe & Co. F. C. Patten Company, of Sycamore, Ill., has ordered for general power purposes a 65-kw belted generator and switchboard. The National Meter Company, of Brooklyn, is to be furnished with an 18-kw generator, which is to be direct connected to a Nash gas engine for lighting use. The K. D. Box & Label Company, of Cleveland, Ohio, will be equipped with a 60-kw direct-connected generator switchboard, and with six motors, varying in capacity from 3 to 15 hp for power. Joseph Bancroft & Co., of Wilmington, Del., have called for an 85-kw generator, also for power purposes, this being the fourth order from the same source, and a second order for a 60-hp motor has been secured from the Tietzjen & Lang Dry Dock Company, of Hoboken. This motor will be used in connection with pumping equipment.

VARIOUS C & C FOREIGN CONTRACTS.—The C & C Electric Company, of Garwood, N. J., whose local offices are in the Central Building, 143 Liberty Street, reports receipt of a number of orders for motors, etc., through its British representative, Mr. C. R. Heap, of 47 Victoria Street, Westminster, London, S. W. Two 30-hp slow-speed motors and one slow-speed motor of 5 hp, also 19 motors of from 5 hp to 10 hp have been requisitioned for by R. Waygood & Co., Limited, "lift" engineers, of Falmouth Road, London, S. E. A 60-hp series-parallel equipment has been ordered by Harmsworth Brothers, proprietors of the *London Evening News*. This equipment is intended to be used for driving a Hoe printing press.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, announces recent orders for very large Cross oil filters from the Government Printing Office at Washington, from McIntosh, Seymour & Co., Auburn, N. Y., the engine builders, and from the De Beers Consolidated Mining Company, Limited, of Kimberley, South Africa. It has also received a sixth order from the Calumet & Hecla Mining Company, for Cross oil filters, making 12 of its filters now in use in the different mines. In addition to the extended sale of its goods, which embraces the entire world, the Burt Company finds much satisfaction in a large number of "repeat" orders from the larger concerns.

PRICES OF BRASS GOODS.—During this week the leading brass manufacturers are to meet in New York City to consider the trade situation. Just after the first reduction in the price of copper was announced, a fortnight ago, by the United Metals Selling Company, they held a conference and decided not to reduce the price of their product. They have now reached the conclusion that it would be desirable for trade purposes to make some concessions in the price of brass, and it is expected that at this week's meeting they will make the cut.

TROLLEY WIRE FOR ENGLAND.—The British electrical engineering and contracting firm of Macartney, McElroy & Co., through their local offices, 26 Cortlandt Street, are about to award contracts for 44 miles of No. 00 trolley wire for various British orders, which the company have recently secured. The company will also shortly let contracts on this side for two electric sprinklers, together with equipment and trucks. One sprinkler will have a capacity of 3000 gallons of water, and the other 1800 gallons. They are intended for the Durban electric traction system, South Africa.

THE AMERICAN BRIDGE COMPANY has purchased the properties heretofore owned by the Detroit Bridge & Iron Company, of Detroit, Mich., and the same will hereafter be known as the Detroit Plant of the American Bridge Company. Mr. Max J. L. Fowler has been appointed manager. The plant thus becomes a part of the Western division of the American Bridge Company, under the jurisdiction of Mr. August Ziesing, Western manager.

FOREIGN ORDERS FOR HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Works, through its New York manager, Mr. W. P. MacKenzie, 203 Broadway, has just sold a 150-hp return tubular boiler for an electric light plant in Brazil, also a 25-hp tandem compound belted Ideal engine for installation in one of the United States Government repair shops at Manila.

POWER IN IDAHO.—The American Falls Water Power Company has secured a franchise at Pocatello, Idaho, to put in a power and light plant for that locality. They bring their power in from the American Falls, 26 miles away from the city. Work has been already begun on the plant, which will be pushed through as rapidly as possible. Mr. John A. Tupper is resident manager of the enterprise.

SAVANNAH ELECTRIC COMPANY.—The Secretary of State of Georgia has granted a charter to the Savannah Electric Company, capitalized at $3,500,000. The charter consolidates all of the street car lines in Savannah. The incorporators, except G. C. Nagle, of Chicago, Ill., are Savannah men.

DISSOLUTION OF PARTNERSHIP.—The partnership of the Lawton-Beattie Electric Company, of Cincinnati, has been dissolved, Mr. Lawton retiring. Mr. A. C. Beattie has acquired all the assets and assumed all liabilities, and will continue the business under the title The Beattie Electric Company.

HALL SIGNAL IN ENGLAND.—The *Westminster Gazette* says the American railway signal has entered the English field. The paper announces that the Northeastern Railway has contracted with the Hall Signal Company, of New York, to equip its system.

RAILWAY MATERIAL WANTED.—Mr. M. V. Cheesman, of Columbus, Ohio, writes us that in the near future he will be in the market for electric railway construction material.

FERRANTI, LIMITED, is the new name of the former concern of S. Z. de Ferranti, Limited, of Hollinwood, Lancashire, England.

Special Correspondence.

ENGLISH NOTES.

LONDON OFFICE, ELECTRICAL WORLD AND ENGINEER, Dec. 23, 1901.

UNDERGROUND FOR BIRMINGHAM.—The busy city of Birmingham is going to make an attempt to follow London's example, a local leading firm of solicitors having signified that a London syndicate has empowered them to apply to Parliament for powers to construct a number of underground tubes for that city.

SUNDAY CARS IN SCOTLAND.—The Edinburgh Tramways Company has violated some musty old traditions in the Scottish capital by commencing the regular running of cars on Sunday in the city. It is understood that the number of cars running will not be so large as on week days, but much will depend on the amount of patronage offered by the public. In Glasgow, when the Corporation was taken to task for running Sunday cars, the promise was made that there would be only a modified service. Very soon, however, the service accommodated itself to the desires of the public, who overcrowded the cars, and led to others being put on the various routes. Such undoubtedly will also be the result of the Edinburgh innovation and in the meantime it is interesting to note that the men do not appear to have any objection to the extra day's work as long as they get extra pay.

LONDON DISTRICT RAILWAY.—It was announced some time ago that the whole of this equipment had gone to the British Westinghouse Company, and this is now confirmed, and, as already noted also in your columns, steam turbines will be used instead of engines of the ordinary reciprocating type. As the generators are to be 5000 kilowatt capacity, it will be at once seen that the experiment of using steam turbines will be a most interesting one, no turbines approaching that size having ever been constructed. It is stated that recent tests have proven that steam turbines will compare favorably in economy of steam consumption with the best types of compound condensing engines. The great power-house at Chelsea which will be thus equipped is doubtless intended to supply others of Mr. Yerkes' electric schemes, and it would appear as if London were about to see most important electric developments in railway work. Meantime the Metropolitan Company have issued their specifications for their power-house, and there appears to be a general impression that Ganz & Company, of Budapest, will succeed in carrying off this contract. Though nothing definite has yet been given out, it would appear that the great steam railways who have running powers over the underground lines are already making preparation to equip such of their trains as require to run in the Inner Circle, so that the entering edge of the wedge of electric traction as applied to railway work in England will soon have been inserted with all the important applications as to the future that such a movement involves.

POWER PLANT FOR MANCHESTER.—A large electric railway and lighting plant is now under construction for the city of Manchester. There will be six cross-compound engines of 3000 i. h. p., each direct coupled to three-phase generators at 6500 volts. The engines are by Messrs. Yates & Thom, of Blackburn, and all of the electrical equipment is being supplied by the Electrical Company, of London, which will use the apparatus of the Allgemeine Elektricitäts-Gesellschaft, of Berlin. The engines are supplied with steam at 160 lbs. per square inch. The condensers are worked by continuous current motors, the power for which, and also for the necessary motors required for driving fans, coal carriers, etc., being supplied by three auxiliary generating sets, each of 230-kw capacity. Each of these sets consists of a high-speed Willans engine, direct coupled to a continuous current shunt wound generator, generating current at 230 volts. The excitation of the three-phase generators is taken off the auxiliary plant bus-bars at starting up, and afterward from two motor generators, each of 75-kw capacity, consisting of an induction motor, driving a continuous current generator. Each of these motor generators is capable of supplying the full excitation current for three of the main generators. The main generators themselves are of the revolving field type. The sub-station plant comprises thirty motor-generators each of 250-kw capacity, eighteen of which will be used for traction and twelve for lighting purposes, and further, ten balancers. These motor-generators will be erected at ten sub-stations. The station as above described is already being extended by the addition of two 6000 i. h. p. engines and generators and the sub-stations by forty motor-generators, each of 150-kw capacity. This work is also being carried out by the Electrical Company of London.

General News.

THE TELEPHONE.

MOBILE, ALA.—The citizens of Paint Rock Valley in Alabama are building a co-operative telephone line up the valley from Paint Rock station.

NEW DECATUR, ALA.—The City Council at a special meeting has considered a proposition to put in a telephone system at an established rate of $1 per month for residences and $2 for business houses. F. C. and W. E. Bell, of Chicago, made the proposition.

FORT SMITH, ARK.—Poles are being erected for an extension of the telephone line from Poteau to Cameron. Later on the line will be run to Hackett City and Fort Smith.

SAN FRANCISCO, CALIF.—The independent telephone system which connects the towns of Imperial, Iris, Flowingwell and Calexico, in San Diego County, Calif., has been improved and extended.

SAN FRANCISCO, CALIF.—Mr. W. R. Hewitt, chief of the Department of Electricity of San Francisco, recently prepared estimates on the cost of installing a municipal inter-communicating telephone system in the City Hall.

SAN FRANCISCO, CALIF.—The California Northwestern Railway Company recently installed city and long-distance telephone apparatus for the convenience of the passengers on each of the ferryboats, which ply between its Bay terminal and San Francisco.

OXFORD, CONN.—Clayton C. Sears expects to soon begin the work of rebuilding the telephone line from Southbury to Woodbury.

COLORADO SPRINGS, COLO.—The Colorado Telephone Company has arranged to spend $1,200,000 on improvements next year. It has increased its capital stock from $3,000,000 to $5,000,000. Four new lines will be added between Denver and Leadville.

EAU GALLIE, FLA.—A telephone system has been put in here with five subscribers to begin with.

OLIVER, GA.—The Oliver Telephone Company will soon have finished a new line from Halcyondale. The line will be extended to Hugginsville.

MUSCATINE, IA.—The Wilton Telephone Company has been incorporated; stock, $3,000. J. M. Rider is president.

CEDAR BLUFFS, IA.—The Lisbon Telephone Company will build a line from Cedar Bluffs to Morse next spring.

MASSENA, IA.—An independent telephone company has been organized at this place. D. P. Hogan is interested. George Anstey is president and G. A. Hill secretary.

NORTHBORO, IA.—The Coin & Northboro Telephone Company, capital stock $7,000, has been incorporated by J. P. Young, president; K. J. Herron, secretary, and E. F. Rose, treasurer.

CLINTON, ILL.—The Clinton telephone system is to be modernized and enlarged.

DIXON, ILL.—A farmers' telephone line is being erected between Rock Falls and Tampico.

PEKIN, ILL.—The Citizens' Telephone Company, capital stock $50,000, has been incorporated.

BENTLEY, ILL.—The Hancock County Telephone Company is extending its line into Bentley.

MARTINSVILLE, ILL.—The Martinsville Telephone Company has filed a certificate of dissolution.

PITTSFIELD, ILL.—Pike County Telephone Company has increased its capital from $20,000 to $35,000.

ASTORIA, ILL.—Robert Whitlock has sold the telephone exchange to Cyrus Bucher. Mr. Bucher is interested in the Farmers' Telephone Company.

ABINGDON, ILL.—The Mutual Union Telephone Company has been incorporated with a capital of $2,500. The incorporators are Leonard E. Cutler, William H. Beaver and Nellie A. Cutler.

CARBONDALE, ILL.—The telephone exchanges of this city, Marion, Centerville and Murphysboro, have entered into an agreement with the Central Telephone Company for long distance service. A line will be extended to this city.

CHICAGO, ILL.—An ordinance has been introduced in the Chicago City Council giving the United Telephone & Telegraph Company right to run wires all over the city. This company now only has a franchise in the Hyde Park district.

JERSEYVILLE, ILL.—The Calhoun Telephone Company has secured franchises in Hardin, Hamburg, Brussels and Grafton, and will establish local exchanges at once in the several places. The first line to be constructed will be that between Brussels and Grafton in Jersey County.

JEFFERSONVILLE, IND.—The Cumberland Telephone & Telegraph Company will establish exchanges at New Washington, Utica and Henryville.

ROSSVILLE, IND.—A franchise was granted to the Rossville Home Telephone Company to construct and maintain a telephone line upon the public highways in Carroll County.

PAOLI, IND.—The Orange County Telephone Company has completed its line between this city and Menengo and will further develop the field when suitable weather prevails.

HUNTINGBURG, IND.—The farmers are anxious to have telephone connection and are making arrangements to have the Dubois County Telephone Company extend its lines.

MARTINSVILLE, IND.—The Morgantown Independent Telephone line has been completed to this city and connections can now be had with Nashville and other points in Brown County.

ELKHART, IND.—J. F. B. Kauffman, of Goshen, has bought of L. A. Neff the telephone system at Syracuse, and will reorganize the property under a stock company with a capital stock of $25,000.

LA GRANGE, IND.—The Northern Indiana & Southern Michigan Telephone, Telegraph & Cable Company of La Grange, Ind., will increase its capital stock to $25,000, and will rebuild several of its lines to neighboring towns.

PRINCETON, IND.—The Princeton Telephone Company, capital stock $25,000, has been incorporated by John W. Ewing, Henry J. Krizel, Chas. F. Stevens, L. W. Gudgel, Steele F. Gilmore, Vincent W. S. Trippett and William E. Stilwell.

HENRYVILLE, IND.—This town has only a population of 500, yet it enjoys the distinction of having four independent telephone lines. Recently representatives of the Cumberland Company, of Louisville, were here and secured 22 subscribers for its service.

INDIANAPOLIS, IND.—The annual contract for telephones which the city made last year for the fire and police departments will expire in a few days and the Central Union and New Telephone Companies have been requested to present sealed bids for 1902 service.

INDIANAPOLIS, IND.—The Alamo Telephone Company, of Alamo, capital stock $10,000, and the Princeton Telephone Company, of Princeton, capital stock $25,000, have filed articles of incorporation with the Secretary of State. Exchanges will be established at Alamo and at Princeton.

INDIANAPOLIS, IND.—The New (independent) Telephone Company, of this city, shows a gratifying increase of business for November. The severe weather crippled the lines at places temporarily and put a stop to all construction of new lines, but even with these interruptions December promises well. The year closes with a most gratifying record.

SHELBYVILLE, IND.—The anxiety that has been felt because of the contemplated purchase of the local telephone plant by the Bell Corporation has been wholly dispelled by the purchase of the property by John A. Tindall, David B. Wilson and Daniel Deprez. The company has reorganized, with Mr. Tindall as president, J. C. Deprez secretary and Mr. Wilson as general manager.

MUNCIE, IND.—The City Council has introduced an ordinance to admit a new telephone company. The promoters are W. E. Hitchcock, of this city and Ft. Wayne men, who propose to place the wires underground in the business section of the city and pay to the city 2 per cent. of the gross receipts annually for the term of the franchise, thirty-five years. More than 800 citizens have subscribed for the new service.

INDIANAPOLIS, IND.—There is a contest between Ohio and Indiana to become the banner independent telephone State in the Union. A map recently issued by the United States Telephone Company, of Cleveland, showing the independent development of the two States indicates that the race is a close one. The map forms a striking exhibit of the growth of independent lines in the two States, as no line owned or operated by the Bell Company is shown upon it.

ANGOLA, IND.—The Town Board has refused permission for the Farmer's Telephone Company to extend its line into this city. This concern is generally regarded as the Bell Company in disguise, and Angola business men are objecting. The Steuben County Telephone Company, an independent company, is giving the town and county excellent service. Business houses pay $18 a year and residences $12, with privilege of talking all over the county without toll charges.

DUNKIRK, IND.—The citizens have arranged to put in an independent telephone system in opposition to the Central Union Telephone Company, which has 225 telephones in operation. The new company has sold sufficient stock to put in the plant, and from the business men alone has secured contracts for 150 instruments. W. C. Porter and George Whitigar are the chief promoters and they announce that the work of installation will proceed immediately. With the installation of the Dunkirk plant nearly all the eastern part of the State will be supplied with independent service, and over these systems much of it already has communication with the State Capital.

FRANKFORT, IND.—The telephone question is up again in this city. The present trouble is the result of the Bell Company announcing a coming increase in rates and the fact that the central energy plant (independent) will soon be sold by order of court to satisfy claims. The central energy plant was installed by John H. Murphy and other Indianapolis men. Under the terms of its franchise the maximum rates were fixed at 75 cents per month for resident telephones and $1.50 per month for business instruments. The company erected a fine plant and the people supported it. Then the Bell cut rates to 50 cents per month for residences and $1.25 for business houses. The people generally stayed with the independent company, but the latter's affairs got tangled, a receiver was appointed and the plant is to be sold. Everybody believes that the Bell will buy it. In the meantime the Bell announces a new rate of $1 and $2 per month for residences.

PARIS, KY.—The City Council has granted the Fayette Telephone Company of Lexington a franchise for the purpose of maintaining and operating a telephone exchange in this city.

OWENSBORO, KY.—The Southern Telephone Association, of Nashville, has purchased the plant of the Hancock County Telephone Company (independent), together with the toll lines extending from Waitman to Cloverport, Ky. The Nashville Company is friendly to the Cumberland Company of this city. The sale makes a break in the system of independent toll lines in process of construction between this city and Louisville.

JENNINGS, LA.—Arrangements have been completed for a telephone line to the oil fields by the Cumberland Telephone Company. The companies drilling at the Jennings fields have arranged to make use of the service.

BOSTON, MASS.—The new Bell Telephone Company to be formed to take over the Erie Telephone properties will start off Jan. 1 with 162,500 telephone subscribers distributed as follows: Arkansas and Texas, 48,000; Cleveland, Ohio, 14,500; Minnesota and Dakotas, 24,000; Michigan, 52,000; Wisconsin, 24,000. The estimated gross income for 1902 is placed as high as $6,500,000.

AUGUSTA, ME.—The Dirigo Telephone Company has been granted its petition to enter the city of Augusta.

ALMA, MICH.—The Union Telephone Company, of Alma, has increased its capital stock from $200,000 to $250,000.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company, of Grand Rapids, will install an exchange at Belding.

KALAMAZOO, MICH., may have an independent telephone system. J. B. Ware, manager of the People's Telephone Company, Detroit, Mich., and D. L. Berry, of Jackson, have asked for a franchise.

GRAND RAPIDS, MICH.—The Michigan Telephone Company has announced an advance in its rates in Detroit and Grand Rapids. Since the opening of the independent telephone company war, both here and in Detroit, the company's rates have been $12 for residences and $18 and upwards, according to distance, for business houses. The Citizens' Company in this city started out with a rate of $18 for residences and $24 for business houses which is limited by ordinance as the maximum. The Detroit rates for the independent telephones were similarly low. The announcement of the advance made by the Michigan company came as a surprise, and already the company has received a number of orders to take out telephones in this city. All business houses in this city are at present provided with both telephones, but an association of local business men is at present considering the question of abandoning the Erie Company instruments on account of the advance.

DARKSVILLE, MO.—B. W. Wright has purchased J. S. McCormick's interest in the telephone line from here to Huntsville.

PIPESTONE, MINN.—The Southwestern Minnesota Telephone Company has filed amended articles of incorporation fixing its capital stock at $150,000.

BLOOMING PRAIRIE, MINN.—At a recent meeting of the directors of the Steele County Telephone Company it was decided to make extensions, including lines to Waltham, Geneva and Ellendale.

PLAINVIEW, MINN.—The Greenwood Telephone Company, with an authorized capital of $25,000, has been organized to build independent lines connecting Plainview, Weaver, Thellman, Kegan and Beaver.

MINNEAPOLIS, MINN.—It is stated that the owners of the independent telephone lines in Wisconsin, Minnesota and northern Michigan will unite to form a long distance toll line service in the northwest to compete with the Erie system in this section. It is said that the Milwaukee Telephone & Telegraph Company, which is now seeking a franchise in Milwaukee, is a part of the proposed new company. It is also rumored, though denied by President Moulton, that the Twin City and the Rapid Service companies of this city are to be included in the amalgamation. A meeting of the owners of the independent lines will be held in Milwaukee in February.

BUTTE, MONT.—Mr. Hatton, manager of the Rocky Mountain Bell Telephone Company at Butte, is at Deer Lodge for the purpose of installing a new pole line in that city.

KANSAS CITY, MO.—The People's Telephone Company, with a capital of $50,000, all paid up, has been incorporated by Henry Wood, John Enoch, Charles B. Stark and others.

OMAHA, NEB.—An order has been secured from the courts, restraining the Plattsmouth Telephone Company from erecting poles or lines in the city of South Omaha until a franchise is secured.

OMAHA, NEB.—The Camp Dewey Telephone system, of which M. C. Thiesen is proprietor, has been pushing its lines quite extensively of late. The system now reaches all points and connects with the O'Neil Telephone Company on the west, the Interstate Telephone Company on the north, the Western Electric Telephone Company on the East and the Nebraska Telephone Company on the south, and includes 225 miles of toll lines. It has 135 local subscribers in Creighton, Neb. Quite a number of ranchmen's lines are connected, and others are building. Material is on the ground for an electric light plant here. Water power from the Verdigre River will be used for the generation of electric energy.

ATLANTIC CITY, N. J.—The Town Council of Absecom has granted the Interstate Telephone Company permission to erect poles and string wires through the town, conditional upon rights of way being obtained from the property owners upon whose land the poles are to be erected.

HALIFAX, N. S.—An increase in the rates has been announced by the Nova Scotia Telephone Company for the city of Halifax from $25 to $35 per year for residences. The City Council will take the matter up.

ITHACA, N. Y.—A telephone line from South Worcester to Summit and Charlottesville is being built.

ITHACA, N. Y.—Ithaca Telephone Company has been incorporated; capital stock, $75,000. Directors: E. C. Stewart, C. H. Blood and J. T. Newman, of Ithaca.

UTICA, N. Y.—The Utica Home Telephone Company has been incorporated, with a capital stock of $200,000. Directors: Charles Poole, Henry F. Miller, Edgar B. Odell, Edward Bushinger, A. Benjamin Tyler, Herbert C. Sholes and T. Henry Ferris, of Utica.

ALBANY, N. Y.—The Inter-Urban Telephone Company, of Utica, has been incorporated to operate a telephone system connecting New York City, Albany, Rochester, Syracuse, Buffalo, Utica, Binghamton, Ogdensburg and other large cities of the State. The capital is $250,000. The directors, all of whom are residents of Utica, are D. Clinton Murray, John D. Kernan, Frank L. Jones, John J. Town, J. Francis Day, Hugh White and Charles I. Williams.

VICKERY, OHIO.—A new telephone line is being built from Clyde to this village.

CHASE, OHIO.—The Irwin Valley Telephone Company, capital stock $300, has been incorporated.

MT. BETHEL, OHIO.—The People's Telephone Company will erect another new line in this vicinity.

SALEM, OHIO.—The Salem Railway will build a private telephone line from Salem to Washingtonville.

BATAVIA OHIO.—The Citizens' Telephone Company will build a branch exchange at Williamsburg.

SALEM, OHIO.—The Columbiana County Telephone Company will establish an exchange in Calcutta.

FAIRVIEW, OHIO.—The Union Telephone Company has increased its capital stock from $10,000 to $25,000.

HAMILTON, OHIO.—The Central Union Telephone Company is building a new line from Hamilton to Mason.

WEST ELKTON, OHIO.—The Gratis Telephone Company will install an automatic exchange at West Elkton.

FRANKLIN, OHIO.—The Miami Construction Company has made application for a franchise for a telephone line.

ALLIANCE, OHIO.—Farmers of Beaver Township are organizing a company to build a system for their own use.

WAUSEON, OHIO.—The Fayette Telephone Company is planning to build a number of extensions in Fulton County.

WESTON, OHIO.—The local exchange will put in a new 100-drop switchboard, which will accommodate 400 subscribers.

CIRCLEVILLE OHIO.—The Circleville Citizens' Telephone Company is building a toll line to New Holland and Washington C. H.

HUDSON, OHIO.—The Central Union Telephone Company has announced a one-minute service rate between Hudson, Bedford and Cleveland.

MILFORD, OHIO.—The Citizens' Telephone Company will build a toll line to Pleasant Hill, Elenor, Belfast, Boston, Newtonsvile and Goshen.

TROY, OHIO.—The Progress Telephone Company is adding a new switchboard to its exchange at West Milton. About 230 lines are now connected.

NEW LEXINGTON, OHIO.—The Hocking Valley Telephone Company has been granted a franchise for an exchange in this place. Work will start at once.

MENTOR, OHIO.—The annual meeting of the Mentor Telephone Company will be held Jan. 20. New officers will be elected and improvements decided upon.

MASSILLON, OHIO.—The Massillon Telephone Company is building lines to Canal Fulton giving the latter place direct communication with Manchester and Canton.

FAIRVIEW, OHIO.—The Union Telephone Company has increased its capital stock from $10,000 to $25,000. O. V. Wells is president and E. P. Shipley, secretary.

MARYSVILLE, OHIO.—The Marysville Telephone Company is constructing a farmers' line to Pharisburg and Bonnette. A number of subscribers has been secured for the line.

LUCAS, OHIO.—The Monroe Telephone Company has increased its capital stock from $500 to $5,000 to provide for improvements. E. E. Culler is president and J. F. Culler, secretary.

BEREA, OHIO.—The Berea Telephone Company is meeting with good success in building up a farmers' system. The local exchange has 200 connections, Strongville 43 and Columbia 35.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association has its solicitors out for subscribers under the new nickel-in-the-slot machine plan, and it is stated that they are taking many contracts.

EAST LIVERPOOL, OHIO.—The Columbiana County Telephone Company is stringing new wires from East Liverpool to Toronto. Work has been delayed through the inability to secure copper wire.

YOUNGSTOWN, OHIO.—The Beaver Township Independent Telephone Company has appointed a committee to sell stock and secure subscription for a farmers' community system which it proposes to build.

WAPAKONETA, OHIO.—The Auglaize Telephone Company, which connects several towns in the county, will extend its lines to St. Johns, Westminster, West Newton, South Warsaw, Holden, Layton and other towns.

LONE STAR, OHIO.—The Wellston, Mineral & Athens Telephone Company of Lone Star, has been incorporated; capital $2,000. Incorporators: R. M. McMangle, F. M. Wood, L. A. Rasson, B. D. Turner and S. J. Jeffers.

KENTON, OHIO.—The directors of the Kenton Home Telephone Company have authorized improvements in the exchange. There will be a large increase in cable capacity and a new board and new instruments will be installed.

BELLEVUE, OHIO.—The Flatrock Telephone Company has completed a farmers' line from Bellevue to Colby, connecting the exchange with Clyde and other large towns in this vicinity. The company is also building a line to Fireside.

GENEVA, OHIO.—The Madison Telephone Company has been given two weeks in which to remove old wires and poles and improve the service in other ways. The company has announced that it will thoroughly overhaul the Geneva system.

IRONTON, OHIO.—The Central Union Telephone Company has a prosperous exchange here. The company has 600 subscribers in the city, and is preparing to connect up 50 farmers' lines and 60 in the neighboring town of Russell.

MARIETTA, OHIO.—The West Virginia Western Telephone Company has completed the work of laying a cable under the Ohio River, connecting Parkersburg and Marietta, giving Marietta connection with the numerous exchanges in West Virginia.

FINDLAY, OHIO.—The Central Union Telephone Company has opened a general supply house at Findlay. A large amount of work is being done on the Findlay exchange. The company has about 1100 subscribers in the city and 250 on farmers' lines.

MILLERSBURG, OHIO.—The Killbuck Telephone Company, which for six months has been endeavoring to secure a franchise in Millersburg, has taken its case to the Probate Court and secured the desired grant. The town will appeal from the decision.

PAINESVILLE, OHIO.—The Painesville Telephone Company has issued an announcement that there is no truth in the report that rates are to be increased after the first of the year. The rates are: Party line, $12; residence, $10, and business, $24.

CHILLICOTHE, OHIO.—The Chillicothe Home Telephone Company is planning to make extensive additions to its switchboard capacity. The Bell Company at Chillicothe has increased its rates, but the Home Company has announced that it will make no change.

CINCINNATI, OHIO.—The Fayette Home Telephone Company, of Lexington, Ky., has bought a franchise for a line between Maysville and Mt. Sterling which will connect a number of Kentucky towns with the Ohio system of the United States Telephone Company.

NEWARK, OHIO.—At the annual meeting of the Newark Citizens' Telephone Company held Dec. 18, new directors were elected as follows: Edward Kibler, C. H. Spencer, J. K. Hammill, Henry Swisher, W. S. Weiant and J. C. Brennan. Another meeting will be held Jan. 6.

KENT, OHIO.—The Kent Telephone Company is making excellent progress under the management of W. H. Butler. The service has recently been extended to Freedom, Freedom Station and Mantua, and next spring a line will be built to Windham. About 500 subscribers are served.

MT. VERNON, OHIO.—The Mt. Vernon Citizens' Telephone Company recently built a farmers' system in the vicinity of Johnstown. At present there are 106 telephones in the system with 40 subscribers waiting to be connected. Subscribers are given connection with all parts of the county as well as with the main exchange.

WOOSTER, OHIO.—The Central Union Telephone Company has applied to the Wayne County Probate Court to grant it a franchise in Wooster under the ruling of the Supreme Court, which says that the Probate Court may grant a telephone franchise where the company and city officials have been unable to come to terms.

CLEVELAND, OHIO.—The Springfield Home Telephone Company has practically completed its underground system. Construction work will start in the near future on an exchange building and headquarters. The company has secured about 1200 subscriptions thus far, and the exchange will be placed in operation about May 1.

FINDLAY, OHIO.—The Findlay Home Telephone Company is preparing plans for the installation of branch exchanges at Arlington, Rawson, and Arcadia in Hancock County. The company has placed an order for 400 additional pairs of cables for city use. It has 150 subscribers in the northern part of the city, on the waiting list.

CRESTLINE, OHIO.—Considerable improvement has recently been made to the exchange of the Crestline Telephone Company. The exchange has been enlarged, giving a capacity of 400 telephones. The company has at present 200 subscribers, but the number is increasing rapidly. A country line has been constructed six miles east.

MANSFIELD, OHIO.—The new exchange of the Mansfield Telephone Company will be placed in operation within a few days. The exchange has been equipped with switchboards of 2000 lines capacity. The company gives service to 500 subscribers outside of Mansfield. The rates for metallic individual lines are $18 for residences and $30 for business.

MASSILLON, OHIO.—The Massillon Telephone Company is making extensive improvements to its system. A new switchboard has just been installed and another has been ordered. Since Jan. 1 last the company secured over 500 subscribers, and the list at present numbers 850. At the first of the year the company is to be consolidated with the Stark County Telephone Company.

CHAGRIN FALLS, OHIO.—Farmers in Ford and Auburn Townships of Geauga County are organizing the Geauga Farmers' Telephone Company. The company will be managed exclusively by farmers on the co-operative basis and service will be furnished at actual cost. Connection will be made with the lines of the Geauga County Telephone Association making the service in that county the most complete of any county in the State.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association of this city has been made defendant in a suit to test the validity of its franchise. A local attorney, named John Rogers, brings the suit. He claims that the incorporated name of the company was not in existence when permission was given to it by the Common Council to operate. This was March 12, 1873; the charter of the association is dated July 5, 1873, four months later.

CLEVELAND, OHIO.—It is reported that as a result of the purchase by the American Telephone & Telegraph Company of the controlling interest in the Erie Telephone & Telegraph Company, the Cleveland Telephone Company, one of the divisions of the Erie, will be operated in connection with the Central Union Telephone Company. It is said that such a change will result in the introduction of so-called Bell methods and fiercer competition than has been the rule in Cleveland under the present management. Manager Yensen claims to have no knowledge of any proposed changes.

CLEVELAND, OHIO.—The Cincinnati Bell Company is just announcing the system of telephone toll charges which the Cleveland Bell Company is endeavoring to abandon as undesirable and unprofitable. On Jan. 1 the City & Suburban Telegraph Company of Cincinnati will furnish nickel in the slot machines to residences at the rate of $18 per year; at least one call per day is required. Business houses are required to have at least two calls per day at five cents each. This is for four party lines. The company will also furnish two party lines requiring at least four calls per day and individual lines requiring five calls per day.

CINCINNATI, OHIO.—Judge Ferris has decided that a franchise granted by a city can not be transferred without the city's consent, accordingly he set aside the court entry transferring from Philip Fitzsimmons to the Fitzsimmons Telephone Company, the famous Fitzsimmons telephone franchise. The court intimated that under the recent Zanesville franchise decision by the Supreme Court, a city has no right to grant a franchise to an individual. On this ground the city will probably bring suit to test the validity of the Fitzsimmons franchise, which is for an independent system in Cincinnati. Prominent capitalists are endeavoring to use the franchise to build a new system, but the decision will probably disarrange their plans.

CLEVELAND, OHIO.—The Springfield Home Telephone Company and the Xenia Citizens' Telephone Company have been consolidated as the Springfield-Xenia Telephone Company. The combined capital stock is $500,000, and officers are as follows: N. I. Dreyfoos, Cleveland, president; S. W. McGrew, Springfield, vice-president; M. Shoup, Xenia, second vice-president; L. M. Blatt, Cleveland, secretary; L. M. Wolfe, Cleveland, treasurer. The above, with C. D. Juvenal, Upper Sandusky; P. E. Montanus, Springfield; John B. McGrew, Springfield; C. W. Collister, Cleveland, and E. E. McGarvey, Xenia, constitute the board of directors. The company has exchanges in operation in Jamestown, Xenia, and Yellow Springs, and is building a large exchange at Springfield, which will be the headquarters of the company.

BATAVIA, OHIO.—A combination will be formed by the Batavia Telephone Company, the Citizens' Telephone Company and the Franklin Construction Company, to compete with the City & Suburban Telegraph Association. The company will be called the Citizens' Telephone Company, and will have headquarters at Batavia. New officers are as follows: B. W. Gilfillan, president; J. W. Ransom, vice-president; W. H. Baum, secretary-treasurer. The Batavia exchange was opened Jan. 1, 1901, with a list of about 40 subscribers. This exchange has made very satisfactory growth, as have the exchanges at Milford, Loveland and New Richmond, which were opened later. At present there are over 400 subscribers connected up, with toll stations at 36 places in this section. The

farmers are asking for connection faster than they can be taken care of, and it is predicted that 1000 telephones will be installed in the county in due course of time.

WOODWARD, OKLA.—The Home Enterprise Telephone Company has been incorporated, with a capital stock of $10,000 by C. R. Alexander, E. S. Wiggins, Geo. H. Brophy and others.

HARRISBURG, PA.—The Common Council of the Borough of Montrose has granted a franchise to the People's Union Telephone Company to set poles etc., through the streets of the borough. The line will extend from Forest Lake to Montrose, thence to Franklin Forks.

QUEBEC, QUE.—The St. Lawrence Telephone Company has been organized at St. Francois du Lac, in the province of Quebec, with a capital of $15,000. J. Allard, M. P. P., is interested.

WOODRUFF, S. C.—The Bell Telephone Company in building its long-distance line between Spartanburg and Columbia, S. C., will put in an office at Woodruff.

BEAUFORT, S. C.—R. A. Long has completed arrangements for a new telephone system. The Sumpter Telephone Manufacturing Company, it is stated, has been given the contract for the necessary equipment. The Bell Company is already maintaining an exchange.

ANDERSON, S. C.—The Consolidated Telephone Company, of Columbia, S. C., has had recorded a charter preparatory to beginning business. The company has headquarters in Columbia and the capital stock is $500,000. The reason for recording this charter is said to be the company's purpose to build a long-distance line from Greenville, S. C., to Anderson and from Anderson to Columbia.

ABERDEEN, S. D.—The Dakota Central Telephone Company is extending its lines to Fort Yates. A line is also being constructed between Doland and Huron.

HEMPSTEAD, TEX.—The Commercial Telephone Company is building a line from Houston to this place.

ABILENE, TEX.—The Texas Telephone Company has increased its capital stock from $6,000 to $12,000.

McMINNVILLE, TENN.—The Citizens' Telephone Company has elected officers. W. S. Lively is general manager. The company has called for bids on poles. Over 100 citizens are pledged to use only this system.

NASHVILLE, TENN.—The Cumberland Telegraph & Telephone Company will make a number of improvements during the coming year and an increase in capital has been authorized. The new issue will be 25 per cent of the present capital, making a total of nearly $2,000,000.

NASHVILLE, TENN.—Parties representing the Tennessee Telephone & Telegraph Company have met a special committee of the City Council. Assurance was given that money was in readiness for building the plant. Also that if the contract desired by the president of the Nashville Telephone Company was legal, that the Tennessee Telephone Company would pay $150,000 for said contract. The meeting adjourned subject to the call of the president.

SALT LAKE CITY, UTAH.—A local telephone exchange is being put in at Miles City, Calif. S. M. Farmer will be the proprietor.

SALT LAKE CITY, UTAH.—H. D. Maiz and a party of Chicago capitalists have formed a company to purchase the Harrison Telephone Company, whose lines run through the Black Hills, in South Dakota. The new company will erect its own building in Deadwood and a $15,000 switchboard.

SALT LAKE CITY, UTAH.—The Bell Telephone Company has completed its line into Billings, Mont., and Douglass, Wyo., and exchanges are being installed at Douglass, Casper, St. Anthony and Rexbury. The company is also arranging to string a line from Montpelier to Afton in Star Valley. The company is closing up a very prosperous year, with a fine outlook for the coming year.

HAMPTON, VA.—The reported offer to sell on the part of the Hampton Telephone Company to the Bell Company is denied by H. H. Carr, the largest stockholder in the Hampton Company. A fight has been on in Hampton since the Bell Company applied for a franchise, but the Ordinance Committee has decided to recommend to the Town Council that a franchise shall not be granted either to the Bell Company or the Phœbus Company, another applicant.

ST. ALBANS, VT.—At a meeting of the stockholders of the Franklin County Telephone Company the following named officers were elected for the ensuing year: President, J. H. Abbott; vice-president, S. W. Flinn; secretary and treasurer, M. P. Abbott; auditor, V. P. Abbott; directors, J. H. Abbott, A. H. Abbott, M. P. Abbott and H. G. Morton. A dividend of 10 per cent was declared. It was also voted to increase the capital stock from $20,000 to $30,000. Mr. M. P. Abbott was reappointed manager of the company. The Franklin Company began business almost two years ago with 150 subscribers; it now has 450, and its business is constantly increasing. It uses the common battery system with lamp signal switchboard and Couch & Seeley apparatus.

SEATTLE, WASH.—The Sunset Telephone Company has taken out a permit for the construction of a three-story addition to its present building on Third Avenue. The addition will cost about $14,000.

SUN PRAIRIE, WIS.—The Dane County Telephone Company has put in a telephone exchange at Waunakee.

STEVENS POINT, WIS.—The Stevens Point Telephone Company will soon put in an exchange. The company will start with 300 subscribers.

MADISON, WIS.—The Farmers' Telephone Construction Company, of Milwaukee, Wis., has reduced its capital stock from $500,000 to $250,000.

OSHKOSH, WIS.—A. W. Bryant, electrical engineer and promoter of independent telephone companies of Oshkosh, has formed a stock company known as the Lake Superior Telephone Company, with $500,000 capital. A system will be built in Ashland, Washburn and Bayfield, Wis., and Iron Mountain and Bessemer, Mich., with toll lines connecting all the above-mentioned cities. Work will begin immediately.

ELECTRIC LIGHT AND POWER.

PRESCOTT, ARIZ.—The Arizona-Utah Light, Power & Canal Company has been incorporated, with a capital of $1,500,000. The officers are: J. F. Welsen, president; H. J. Allen, vice-president; Homer K. Wood, secretary and treasurer; E. M. Gage, J. J. Fisher, J. A. C. Freund and Thomas B. Davis, directors.

VANCOUVER, B. C.—The Vancouver Power Company, of Vancouver, has concluded arrangements with the civic authorities of New Westminster, whereby work may be commenced on the development of the power at Coquitlam Lake.

SOUTH NORWALK, CONN.—The municipal lighting plant reports a clear gross profit of $7,496. It is under the efficient management of Mr. A. E. Winchester. More business offers than the plant can carry and extensions may soon be in order. The city has 120 arcs, and there are 181 commercial customers for light and 33 for power. The plant also has attached to it the fire alarm system.

ORLANDO, FLA.—The new electric light plant has been satisfactorily tested.

LEWISTON, IDAHO.—Mr. Vinson, proprietor of the Walla Walla Marble Works at this place, is organizing a granite works with a capital of $100,000. The carving, polishing and other special machinery will be driven by electric power.

BOISE, IDAHO.—The stockholders of the local electric light company at Boise have given an option on their stock to the Boise-Payette River Electric Power Company. The terms of the sale have not been made public, but it is understood that the amount involved is close to $150,000. The capitalization of the company is $50,000. The Payette Company is establishing a power plant on the Payette River, below Horse Shoe Bend, to furnish power for all purposes, including the mines at Pearl.

POCATELLO, IDAHO.—The American Falls Water Power Company has just secured a forty-year franchise to furnish light and power for the city of Pocatello. The power now comes from Port Neux Creek, which is getting less and less each year as the water is appropriated for irrigating purposes, and it is only a question of time when the city would be without light. The company will put in a 1500-hp plant and will go right to work to secure the business of the Oregon Short Line shops. The company has 10,000 horse-power at American Falls for sale. The company has a capital of $300,000 and was organized last June.

MOUNT STERLING, ILL.—The city has been in semi-darkness for some six weeks, owing to a disagreement between the City Council and the electric light company.

MOUNT VERNON, ILL.—In the Circuit Court the City of Mount Vernon confessed indebtedness to the Mount Vernon Electric Light Company, and judgment in favor of the latter was rendered in the sum of $1,847.98.

RUSHVILLE, ILL.—The electric light plant has been hauling water for fifteen weeks from an old coal mine. This supply having been exhausted, the company notified the City Council that it would discontinue the lights on the streets.

RICHMOND, IND., will try the experiment of municipal electric lighting, and now has under construction a $150,000 plant.

COLON, MICH.—Work has been commenced upon two dams to be built across the St. Joseph River near this place by the Michigan Hydraulic & Electric Company. Eastern capital is backing the company, which will invest $250,000 in a plant to light Colon and surrounding towns and villages. R. Van Schoick, of Albany, N. Y.; Dr. Stewart, of Coldwater, Mich., and Fred. Schurtz and D. L. Akey, of Colon, promoted the scheme and are interested in the company. The Coldwater-Battle Creek interurban line will probably be supplied with power from this plant.

GRAND RAPIDS, MICH.—The new long-distance transmission plant of the Thornapple Electric Company, twenty miles from this city on the Thornapple River, commenced operations a couple of weeks ago and is supplying current for lighting purposes to Hastings and Middleville. A head of eighteen feet of water is available at Labarge. The dam is 160 feet wide and eighteen feet high at the centre. The wheel-pit is equipped with two 45-inch turbines, each capable of developing 300 horse-power. In the power station are two 220-kw, multipolar, 2500-volt generators. Nashville, the farthest point to be supplied, is 25 miles away.

GRAND RAPIDS, MICH.—It is announced that the Newaygo Portland Cement Company, of Newaygo, Mich, has purchased the plant and interests of the Peninsular Light, Heat & Power Company at Lowell, whose plant furnishes a large share of the electricity used for local lighting purposes. The plant was a part of the estate of Fred. Church, of Lowell, and the matter of settling the estate has been in the hands of the Michigan Trust Company, of which L. H. Withey, one of the principal stockholders and the president of the Peninsular Company, is president. As nearly as can be learned the plan of the Newaygo Company is to erect a new dam in Flat River near Lowell to increase the amount of power developed from 300 to 1200 horse-power. The Newaygo Company proposes to erect a new dam in the Muskegon River at Croton, where it is believed 15,000 horse-power may easily be developed at little expense.

GLOSTER, MISS.—Proposals for erecting a waterworks and lighting system will be received until Jan. 7, 1902, all bids to be accompanied with solvent bonds to the amount of $15,000.

MARSHALL, MO.—The citizens at a special election voted to bond the city for $70,000 for the purpose of erecting municipal water and electric light plants.

ST. LOUIS, MO.—It is again reported that the Citizens' Electric Light & Power Company has been purchased by the North American Trust Company of New York, and that the deal is part of the plan of the trust company to consolidate the electric light and power companies of this city. The North American is the company which purchased the Imperial Electric Light, Heat & Power Company.

NEWBERN, N. C.—At a second election matters have been reversed and $15,000 electric light bonds voted.

ROCKINGHAM, N. C.—The new electric lighting system of Rockingham has just been started up.

CHARLOTTE, N. C.—The Carolina Electric Company of Maxton, N. C., has been chartered to furnished light, power and heat. The capital stock is $50,000. W. S. McNair and others are the stockholders.

ALBANY, N. Y.—The Hudson Valley Light & Power Company has been incorporated; capital, $25,000. Incorporators: Harry M. Shon, Henry G. Willis, Peter C. Ackerman, Robert E. Farley, Curtis J. Harrington, Edward E. Shan and Francis F. Barrett.

RAVENSWOOD, OHIO.—This place is now lighted electrically. The new plant has a capacity of 21 arc and 800 incandescents.

CANTON, OHIO.—The Central Heat & Power Company has presented an ordinance for a franchise for a lighting and steam heating plant.

EAST CLEVELAND, OHIO.—The village authorities are discussing the erection of a municipal lighting plant and a committee has been appointed to secure estimates.

UPPER SANDUSKY, OHIO.—J. W. and J. M. Barber, of Columbus, have been granted a franchise in Upper Sandusky for an electric lighting and steam heating plant. They will commence at once on a plant to cost $100,000.

WELLSVILLE, OHIO.—The City Council is dissatisfied with the service furnished by the local lighting company and a motion has been carried empowering the city solicitor to go to court and seek the annulment of the company's franchise.

BROCKVILLE, ONT.—The light commissioners of the city of Brockville have decided to submit a by-law to the ratepayers to raise the sum of $25,000 for improvements to the lighting plant of the city.

OTTAWA, ONT.—Mr. John Knox, of Stayner, Ont., proposes to utilize the Nottawasaga River for the development of electric power. An electrical expert will look over the ground with a view of preparing plans.

MONTREAL, QUE.—It is estimated that the total cost of laying conduits in the city of Montreal, Que., for the use of the various electrical concerns doing business in the city, will be upwards of $7,500,000.

MONTREAL, QUE.—The Royal Electric Company has signed the lighting contract with the city of Montreal, under which, after Jan. 1, 1903, the company will get a five-year extension of its present contract with the city at the price of $60 per arc lamp, instead of $120 per lamp under the old contract.

SALT LAKE CITY, UTAH.—A. B. Frame, of Baker City, Ore., representing Eastern capital, has asked to be given a franchise to install and operate an electric light plant at that place.

HYRUM, UTAH.—The articles of incorporation of the Union Electric Light & Power Company, of Hyrum, have been filed. F. J. Wright, president; J. Howell, vice-president; M. Wright, G. F. Wright, secretary and treasurer; W. C. Parkinson, E. R. Owen, T. A. Kerr.

PROVO, UTAH.—A communication was received from the local electric light company of Provo, offering to furnish electric lights to Dec. 31, 1902, for 50 cents per month for each light, and $25 per month for the renewing and replacing of lamps. The offer was accepted.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company during November expended nearly $10,000 in improving its plant, aside from cost of maintenance and labor. These improvements included new transformers, arc lamps, meters, etc. The company is in readiness to expend a large amount of money in further developments when the time arrives.

LA CROSSE, WIS.—The transfers in the consolidation of the La Crosse Gas Company, the La Crosse Brush Electric Light Company and the La Crosse Edison Light & Power Company. The name of the consolidated concern is that of the La Crosse Gas & Electric Company, and the officers are: President, W. W. Cargill; vice-president and general manager, George McMillan; treasurer, W. S. Cargill; secretary, James B. Taylor.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—Application has been made for a street railway franchise in this city by George S. Leatherburg, Jr., and associates.

MOBILE, ALA.—The City Attorney has been instructed to determine what the city's rights are to annul one of the franchises of the Mobile Street Railway Company on the grounds of non-compliance.

CHICAGO, ILL.—The item in a recent issue with reference to the destruction by fire of 200 trolley cars and the barn of the Chicago Union Traction Company was erroneous in one particular. From later reports it appears that they were not trolley cars, but cable cars. The loss is estimated at $165,000, covered by insurance. This is one of the most important cable lines in the city.

WARSAW, IND.—A $25,000 subsidy has been voted to the Logansport, Rochester & Northern Electric Traction Company, which is to build a line from Logansport to Kendallville.

INDIANAPOLIS, IND.—The Fort Wayne Northern Traction Company and the Fort Wayne Southern Traction Company, each capitalized at $25,000, have been incorporated by W. B. McKinley, of Champaign, Ill.; H. E. Davidson, John R. McCulloch, P. R. Stephens and R. S. Nelson, of Ft. Wayne.

RICHMOND, IND.—Another electric line is promoted to make this city its western terminus. For the purpose the Richmond & Greenville Electric Railway Company has been organized. The road is said to be backed by the Henry Clews Banking Company, of New York. It is the purpose of the company to build in both directions from Greenville.

LOUISVIILE, KY.—T. C. H. Vance has asked the City Council to grant a street railway franchise on all unoccupied streets.

HOLLAND, MICH.—The town board of Holland Township has granted the Grand Rapids, Holland & Lake Michigan Railway Company a franchise to furnish energy for lighting in the township. The township of Laketown adjoining has granted a similar franchise. This gives the company the right to do a lighting business in the various summer resorts on the lake branch of the Holland line. A plant will be erected at Virginia Park and will be in operation next spring.

GRAND RAPIDS, MICH.—If lines now being actively promoted and soundly backed to all appearances are completed, there will be a continuous interurban line around the base of Lake Michigan, from Grand Rapids to Chicago. It will be by way of St. Joseph, South Bend and Michigan City. The Grand Rapids, Kalamazoo & St. Joseph Traction Company is rapidly securing the necessary options for the extension of its lines from Holland to St. Joseph. The Indiana Railway Company has already begun the construction of a road between St. Joseph and South Bend, and this line is expected to be completed during the next summer. The Chicago & Indiana Air Line will make the last link in the chain of roads. Eastern capitalists have this road in mind, and it is projected by way of Hammond and Michigan City, between South Bend and Chicago. The Grand Rapids, Grand Haven & Muskegon road, which will be in operation within sixty days, would make still another link in the chain of electric roads from Chicago to the most important lakeport on this side of the lake.

ALBANY, N. Y.—The Albion Electric Railway has been incorporated; capital, $30,000.

ASHTABULA, OHIO.—The directors of the Pennsylvania & Ohio Railway have decided to make the proposed extension to Jefferson.

OTTAWA, OHIO.—The Ottawa Council has granted a franchise through town to the Toledo & Lima Traction Company.

SEBRING, OHIO.—The Stark Electric Railway which is building between Canton and Alliance, has applied for a franchise in Sebring.

NORWOOD, OHIO.—The Cincinnati & Columbus Traction Company has asked the Council for a franchise for a double track line through the town.

NEW WASHINGTON, OHIO.—The Village Council has granted a 25-year franchise to the Buckeye Traction Company, to operate over a route established some months ago.

CANTON, OHIO.—General Manager Currie, of the Northern Ohio Traction Company, is planning to make extensive improvements to the Canton-Massillon Railway, which has recently been acquired.

GREENSPRING, OHIO.—The Village Council has granted a franchise to J. C. Parker for the Sandusky, Clyde, Tiffin & Southern Railway. The Clyde Council will grant a franchise at the next meeting.

CLEVELAND, OHIO.—The attorneys of the Everett-Moore syndicate are preparing plans for the consolidation of the Cleveland & Eastern, the Cleveland & Chagrin Falls and the Chagrin Falls & Eastern Railways.

YOUNGSTOWN, OHIO.—A new syndicate, said to be composed of New York and Chicago capitalists, has taken up the proposition for a line from Youngstown to East Liverpool, and is securing right of way.

ADDISON, OHIO.—Citizens of Addison want the Dayton, Springfield & Urbana to build a branch line from Springfield to Piqua through Addison. A committee has been appointed and rights of way for the line are being secured.

CLEVELAND, OHIO.—The Cleveland City Railway Company will increase its capital stock $1,000,000. The annual and a special meeting of the stockholders will be held Jan. 20, for the purpose of electing a board of directors; also of voting on a proposition to increase the capital stock from $8,000,000 to $9,000,000.

YOUNGSTOWN, OHIO.—The coke and coal situation which confronts manufacturers in this section is becoming more serious every day. Several times within the past ten days the Mahoning Valley Railway has been forced to resort to burning old ties, and it is feared that it may yet be necessary to shut down the power-house.

DAYTON, OHIO.—The Dayton & Lebanon Railway has filed a mortgage for $2,000,000 in favor of the Cincinnati Trust Company. The company proposes to utilize the old Dayton, Lebanon & Cincinnati Railway for electric and steam propulsion, and an extension may be built from Lebanon to Cincinnati. The road is controlled by A. E. Appleyard, of Boston, who also controls the lines between Dayton and Columbus.

POMEROY, OHIO.—The Ohio River Electric Railway & Power Company has purchased the entire plant and equipment of the Pomeroy & Middleport Electric Company. It will be moved to the power-house of the purchasing company and new machinery added. The new company will at once arrange for the development of commercial and private lighting, and contemplates extending the service to Minersville, Syracuse and Racine.

CINCINNATI, OHIO.—The immense power-house of the Cincinnati & Eastern Traction Company, near California, is nearly completed and the equipment is being installed. The station will furnish current for three interurban lines now under construction by Cincinnati interests, which are largely identical. They are the Cincinnati & Eastern to Richmond, the Suburban Traction Company to Bethel and the Rapid Railway Company ,to Lebanon. The Richmond and Bethel lines will be placed in operation about May 1 and the Lebanon line about Sept. 1.

CLEVELAND, OHIO.—The recently organized Central Ohio Traction Company has closed a deal for the purchase of the property of the Electric Railway & Power Company of Tiffin and the right of way and property of the Toledo, Tiffin & Sandusky Railway. The properties will be merged and the new company will have a capital stock of $600,000. The Tiffin-Fremont line will be completed at once, and it is probable that the Sandusky extension may be built. The new company is headed by James B. McDonnell, of Fostoria, Ohio, and R. S. Vivian, of Chicago.

CLEVELAND, OHIO.—The first car was run through from Cleveland to Detroit over the Everett-Moore system Monday, Dec. 23. The special car "Alpha" left Cleveland at 9:30, having on board E. W. Moore, Barney Mahler, Ira McCormack and other officials of the road, with representatives of several

Eastern bond houses. The party reached Toledo at 4 o'clock, and Detroit in the evening. Mr. Mahler stated that the actual running time from Cleveland to Toledo was 5½ hours, which he considered very creditable in view of the fact that for 32 miles the car was obliged to go very slow, the bonding not having been completed. It was the first car to cross the Vermillion bridge; rails being laid temporarily for the occasion. Regular service will be instituted in a few days between Toledo and Detroit and Cleveland and Toledo.

OKLAHOMA CITY, OKLA.—A franchise for a street railway has been granted to Herold R. Perry, Edmond Harrison, of New York, and A. H. Craney, of St. Louis.

TORONTO, ONT.—Application is to be made to the Ontario Legislature for the incorporation of the Toronto & Hamilton Electric Railway Company.

THE AUTOMOBILE.

THE ST. LOUIS TRANSFER COMPANY, St. Louis, Mo., may substitute automobiles for its drayage wagons and horses. The automobiles that would be required by the company would cost about $1,500 and nearly $400,000 would be invested in them.

A TOY AUTOMOBILE.—George Jay Gould, Jr., nine years old, received from his mother a handsome Christmas present in the shape of a costly toy automobile. The tiny vehicle weighs 200 pounds. It is four feet long and its height from the ground to the seat is two feet. The body is three feet three inches by one foot seven inches. The wheels have pneumatic tires, twenty inches rear and sixteen inches front, with wire spokes. The tires are one and a half inches in diameter. The motive power is electric, obtained from cells weighing 100 lbs. On the right hand is a lever for three speeds, and in front a steering lever. The vehicle will travel from five to seven miles an hour and run twenty miles without recharging. The body is painted black, with the seat raised, double lazy-back, and hood behind in red. The wheels are red, with narrow black stripes. The seat is upholstered in maroon leather.

PERSONAL.

MR. JOSEPH B. CROCKETT has resigned the presidency of the San Francisco Gas & Electric Company.

MR. M. A. BEAL, secretary of the Rockford Edison Company, of Rockford, Ill., gave a banquet to the employes of the company the evening of Dec. 27, 1901.

MR. W. A. ROSENBAUM announces that he has now moved his offices for patent soliciting to the Nassau-Beekman Building, 140 Nassau Street, New York City.

MR. ROBERT DARLING, general manager of the United States Battery Company, has been elected vice-president of that concern, but will continue to hold his former office.

MR. ARTHUR WARREN, who has been so successful a representative of the Westinghouse interests in Europe, and who has been on a brief trip from England to this country, has sailed again for the other side.

M. A. VERNER, of Pittsburg, who is associated with Sellars McKee, of the same Pennsylvania city, in a project looking to the construction of an extensive electric traction system in St. Petersburg, returned this week from Russia.

REEL-PRESTON.—At Kingston, N. Y., on Dec. 28, Miss Charlotte Preston, daughter of Charles M. Preston, a banker of Kingston, was married to Charles Gordon Reel, superintendent of the Consolidated Street Railroads of Kingston.

MR. EDWARD H. TYLER has been appointed chief engineer of the Brush Electrical Engineering Company, Ltd., of England, an old, large and very progressive electrical manufacturing corporation, with a large domestic and foreign business.

DR. M. I. PUPIN had in the *New York World* of December 29 a very clear and interesting discussion of wireless telegraphy, in popular language with diagrams. He holds, however, that "Wireless telegraphy is too slow for commercial use, as compared with the cable," and he shows why.

SULLIVAN—MERCER.—Mr. Hazen P. Sullivan, superintendent of the Peru Electric Manufacturing Company, Peru, Ind., was married on Dec. 17 to Miss Venice E. Mercer. The event was of much social importance, and Mr. and Mrs. Sullivan received the congratulations and good wishes of a large number of friends.

GIBSON-JACKSON.—The marriage is announced, on Christmas Day, of Anna, daughter of Mr. and Mrs. Luis Jackson, to Mr. George H. Gibson, of the publication department of the Westinghouse Companies at Pittsburg. Mr. and Mrs. Gibson will be at home after Feb. 1, at 268 Shady Avenue, East End, Pittsburg.

MR. JOSEPH A. McELROY, of the British electrical engineering and contracting firm of Macartney, McElroy & Company, New York offices, 26 Cortland Street, who has been on a visit to this country for the last four weeks, intends to return to Europe by the North German Lloyd liner *Kronprinz*, which sails January 4.

MR. A. L. RIKER, when in New York last week, confirmed the reports noted by us as to his resignation from the Electric Vehicle Company. It takes effect Jan. 1. Mr. Riker has been a very active man during the past two or three years, and will take a brief but much needed rest. He will then pull himself together for new work in the automobile field.

MR. HENRY C. PAYNE, the new Postmaster General, is credited in electrical circles with having begun his successful electrical career as a telegraph operator. We learn, however, that while Mr. Payne learned telegraphy and was an expert operator, he never worked at the key as a means of livelihood. When the telephone came along, he was quick to see its great utility and future.

BOWKER-MITCHELL.—A special dispatch from Boston of Jan. 1 says: "Richard Rogers Bowker, of New York, and Miss Alice Mitchell, of Cambridge, were married to-day at Brookline by the Rev. Edward Everett Hule. The ceremony was a very quiet affair, but a notable alliance owing to the high standing of the contracting parties. Miss Mitchell is a niece of former Vice-President Morton, and a young lady of rare beauty. She has been a leader in Boston's society and prominent in much of the philanthropic work of this city. The bridegroom was for a long time vice-president of the Edison Electric Lighting Company, and is at present identified with the publishing business as proprietor of the *Publishers' Weekly*, etc., of New York City; the *Library Journal*, etc. He is also prominent in reform, social and political movements."

MR. MARSDEN J. PERRY.—The marriage of Mrs. Marion Lincoln Bogert, formerly of Hamilton Park, to Mr. Marsden J. Perry, of Providence, is noted, at the home of her mother, Mrs. Lincoln, at Worcester, Mass. Mr. and Mrs. Perry will live in Providence, and will occupy one of the handsomest colonial mansions in New England, built in 1786, and recently purchased by Mr. Perry from the Brown and Ives estate.

MR. W. R. MASON, who for the past six years has been acting as manufacturers' agent in the St. Louis territory, for several prominent electrical machinery builders has returned to Chicago and purchased an interest in the Wagner-Hatch Electric Company, 308 Dearborn Street, and has been elected secretary of the company. This company is agent for the dynamos and motors built by the Reliance Electric Company, of Milwaukee.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, of Ampere, N. J., had an agreeable surprise the day before Christmas. The growth of the business had led to the formation recently of a dining club at the works by the numerous heads of departments, and the club made this occasion a memorable one for Dr. Wheeler by presenting him with a handsome silver loving cup. Unknown to her husband, Mrs. Wheeler was invited over to luncheon, but even she did not know what was intended. A very neat presentation speech was made by Mr. H. L. Patterson, purchasing agent, while the response of the recipient was as hearty and feeling as it was undeniably extemporaneous.

MR. E. P. THOMPSON, the patent lawyer, is out with a vigorous letter in the *New York Times* in defence of Admiral Schley. He says: "The result obtained by a great inventor, or warrior, or statesman, or artist, or the like is not to be judged by his little mistakes (mistakes in the opinion of a few), nor by anything whatever, except by the size of the achievement. No doubt that Marconi's, or Bell's, or Edison's, or Westinghouse's methods of making great inventions could be picked to pieces by a court of mechanical experts (who would, however, be inferiors, for the reason that they had not made great inventions). Ought we not to prefer a charge for neglect of due dispatch against Röntgen for not discovering X-rays fifteen hours sooner than he did? Ought we not to bring a charge against Marconi for making a loop from Newfoundland to Nova Scotia, in spite of whatever private feelings may have been aroused in him by the Anglo-America Telegraph Company? Ought we not to enter a charge for retrograde movements against Pupin for not more quickly perfecting his non-inductive telephone system for talking across the ocean?"

Trade Notes.

SEAMLESS STEEL.—The Standard Welding Company, Cleveland, Ohio, has issued a new price list of its seamless steel tubes, rims, cylinders and boiler flues for automobiles and other purposes.

HART & HEGEMAN SWITCHES.—The Hart & Hegeman Manufacturing Company, Hartford, Conn., announces that all Hart rotary switches will hereafter be supplied, should the purchaser so desire, with an "on" or "off" indication free of charge.

THE MARSHALL-SANDERS COMPANY, Boston, has at last caught up with the phenomenal demand for its midget plugs and receptacles, and is now prepared to deliver them in any quantity from stock, having quadrupled its capacity during the last two months.

THE RENIM SPECIALTY COMPANY has removed its office to new and larger quarters in the Weld Building, 176 Federal Street, Boston, occupying an entire floor running through from High to Purchase Street, with freight elevator and every facility for carrying a large stock of Renim specialties.

THE BRISTOL COMPANY, Waterbury, Conn., has just issued its revised recording thermometer circular, which covers recording thermometers for all classes of temperature measurements up to maximum ranges of 800° F. The circular is fully illustrated with views of charts and recording thermometers of different classes. Copies may be obtained on application.

WILLIAMS ENGINES.—In an attractive pamphlet the Quincy Engine Works, Quincy, Ill., gives tables of dimensions, speeds, etc., of the Williams engines built by them, and diagrams of the vertical engines with dimensions are also presented. These engines are built in standard parts, largely interchangeable, and represent the latest development in engine building.

THE WIRT ELECTRIC COMPANY, Philadelphia, Pa., has bound together a number of its circulars in a handsome cover containing embossings of a rheostat. One of the circulars illustrates and describes field rheostats, another motor speed controllers, and the third is devoted to theatre dimmers. The latter contains much information of general interest on the application of dimmers.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing a new bulletin on D. & W. telephone protectors. This protector, which embodies all the necessary elements of such a device, combines a high tension fuse, a zinc coil, and a lightning arrester all arranged on one block making an instrument of neat and compact design. A descriptive bulletin of this material will be sent free to any one upon application.

BRIGHTON GAS AND GASOLINE ENGINES.—In a 40-page catalogue the Pierce-Crouch Engine Company, New Brighton, Pa., illustrates and describes the various types of the Brighton gas and gasoline engines. All of the types and the more important details of this engine are illustrated by excellent engravings and accompanied with full descriptions. The text, in fact, has more the character of technical writing than of the usual trade literature.

ELECTRIC LOCOMOTIVES.—The subject of a recent pamphlet issued by the C. W. Hunt Company is electric locomotives for manufacturing establish-

ments. A number of views of such locomotives operating in manufacturing works are illustrated, and much data of general information concerning the same are given. A storage battery switch locomotive is also described. The final pages of the pamphlet are devoted to industrial railway cars and track.

THE HOLTZER-CABOT ELECTRIC COMPANY, Boston, Mass., has just issued a pamphlet of unique design, containing a list of users of the Ness automatic telephone system, and a few testimonial letters. In the front cover an oval section is cut out of the centre so as to reveal a picture of a telephone set on the first inside page. The color combination of the green cover and buff inside page is very pleasing. The arrangement of the contents of the pamphlet is somewhat out of the ordinary. Most every State in the Union is represented in the list, also Japan.

THE ACME SWITCH COMPANY, Hartford, Conn., has recently increased its capital stock to $25,000, and removed its offices and works to 438 Asylum Street, near the New York, New Haven & Hartford Railroad station. Its floor space here is larger and its facilities are greater. Considerable new machinery has also been purchased. All of this extension has been made necessary by the heavy demand for the time switches which this company manufactures. Two new types of time switches have just been added to the Acme line.

TELEPHONE CONSTRUCTION TOOLS AND MATERIAL.—Messrs. Johnston & Dean, dealers in tools and materials for telephone, telegraph and electric companies, Wainwright Building, St. Louis, Mo., have just issued a neat pamphlet on the subject, "The Use of Aerial Cable." Considerable practical and valuable information is given on this subject and illustrations show various pieces of apparatus used in connection with the installation of telephone aerial cables. All telephone men would be interested in the contents of this pamphlet.

MR. WM. ROCHE, 42 Vesey Street, New York, reports the year just closed as the most successful in his business career, notwithstanding that fire almost destroyed his entire plant last summer. The "New Standard" dry battery, Mr. Roche states, is enjoying a better sale now than ever before, and the new flashlight which he has recently put on the market is giving the best of satisfaction. A new field for this useful article was recently discovered in the police raids in New York city where each of the raiders was supplied with one of these flashlights.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, is in position to show a full line of samples of its generator call exchange and toll line, and central energy telephones, with combined self-restoring drop and jack for generator call switchboards and answering and multiple spring jacks, lamp signals and sockets, relays, ringing and listening keys and the various parts for a full multiple and trunking central energy exchange equipment. The apparatus contains many new features and its design and construction is neat and of the very highest grade.

GERMAN TRADE CATALOGUE.—The Gesellschaft für Elektrische Industrie of Karlsruhebaden has issued a handsome cloth-bound catalogue with a striking design on the cover page, and containing a large number of full-page cuts giving views of its factory and the various types of machinery manufactured by it. The cuts are on the left-hand page, and the descriptive matter on the right-hand page, is in three languages, there being one column for German, another column for French and a third column for English. A very considerable portion of the space is occupied with illustrations and descriptions of electric cranes and hoists.

PULLEY AND CLUTCH TESTS.—Tests have been made at the Worcester Polytechnic Institute, Worcester, Mass., of "Compo" clutches and pulleys for the Allston Foundry Company, Boston, Mass. The reports of these tests have been published in pamphlet form by the Allston Company. The object of the tests was to obtain the relative power transmitting properties of standard pulleys and a leather-faced clutch, and compare them with pulleys of iron and wood with cork insertions in the rim, and a clutch similarly treated. According to the reports upon the tests the cork-inserted pulley transmitted 51 per cent. more power at a slip of 2 per cent. than the others under test, and the cork-inserted clutch showed a corresponding increase in transmission. The Allston Foundry Company, 620 Atlantic Avenue, Boston, Mass., does not itself manufacture clutches, but is introducing cork-inserts into every well-known make of friction clutches, and for friction driving or braking purposes generally.

CALIFORNIA AGAIN.—The water powers of California have lately been a prominent theme in the pages of this journal. Now, the January *Country Life in America* is a California number with superb pictures, and wholly devoted to the outdoor world on the Pacific Coast. The special covers show big trees of the Sierras, and a magnificent frontispiece, the blooming orchards at the foot of snow-capped mountains. The leading article, by L. H. Bailey, tells of the diversified beauties and peculiarities of the land that flowers in winter and sleeps in summer, where thunderstorms are not, and where the sun shines everlastingly. Throughout, the unusual opportunities for illustrating California at its best have been well taken, but of particularly striking beauty are several series of photographs. Of these, "The Cypresses of Monterey" show a picturesque feature of the Southern coast; the Yucca palms and Gila monsters, the weird life in the Mojave desert; and the poppies and poppy-worts furnish the color that gives California its fame as a land of flowers.

THE FRINK REFLECTORS, which have received awards in every exposition in which they have been entered, more recently receiving the highest award at the Pan-American Exposition, Buffalo, where thirty-two of these reflectors were used in lighting the railway station and transportation building, have been adopted for use in lighting the art galleries of the Charleston Exposition, a species of lighting to which they are specially applicable, and in which they reach the highest results. This is an adaptation of their familiar show-window reflector, which hardly needs any introduction to our readers, as it is in use in so many of the representative stores of the country. Mr. Frink is the pioneer of this reflector trade, being, it is said, the original patentee, and in business close to half a century. The name "Frink" has always stood for what is best in the reflector line. In addition to show case and window lighting, store interiors, etc., they make a specialty of church and building lighting, art galleries, etc., no problem in lighting being too difficult for them to solve successfully.

INCANDESCENT LAMPS FOR ISOLATED PLANTS.—The latest addition to the artistic trade literature of the General Electric Company is a handsome 64-page pamphlet on the subject of incandescent lamps for isolated plants. This particular branch of electric lighting gives special opportunities for the exercise of artistic skill, and many beautiful effects are illustrated in the pages of this catalogue. The text describes lamps of voltages from 90 to 125 and 200 to 250, and gives much valuable and interesting information on the general subject. A chapter is devoted to the importance of good regulation. It includes tables showing the effects of change in voltage on 3.1 and 3.5-watt lamps. Scattered throughout the pages are many half-tone views showing decorative lighting features in several of the most prominent hotels in New York City, Trinity Church New York, the Pan-American Exposition, and many other places of note. Views of many of the prominent office buildings in New York are also shown with high artistic effect, in connection with the general subject of the pamphlet.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED DECEMBER 24, 1901.

[Conducted by Wm. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

689,096. ELECTRICAL APPARATUS; T. B. Kinraide, Boston, Mass. App. filed May 4, 1901. The apparatus comprises a plurality of intermittent high potential generating units and means for uniting them in a uni-directional discharge. (Issued Dec. 17.)

689,378. MEANS FOR LIGHTING GAS; H. Borchardt, Berlin, Germany. App. filed Aug. 2, 1900. The invention relates chiefly to the construction of the valves for a pilot light and for the main light. The pilot light is first ignited by electricity, after which the main burner is lighted and the pilot is extinguished.

689,379. MEANS FOR LIGHTING GAS; H. Borchardt, Berlin, Germany. App. filed March 30, 1901. A modification of the preceding.

689,380. MEANS FOR ELECTRICALLY CONTROLLING GAS COCKS; H. Borchardt, Berlin, Germany. App. filed May 28, 1901. A ratchet arrangement operated by an electro-magnet for turning on the gas and igniting it from a distance.

689,406. ELECTRIC EXERCISING APPARATUS; A. Olson, San Diego, Cal. App. filed April 1, 1901. Branch conductors lead from an electric belt to dumb bells or clubs, so that the circuit will include the arms and body of the person exercising.

689,414. SWITCH AND OUTLET BOX; Miner Robinson, Newton, Mass. App. filed Oct. 23, 1901. Projections or pockets from the box receive the end of the conduits in a direction parallel to the face of the box.

689,415. ELECTRIC TELEGRAPH; H. A. Rowland, Baltimore, Md. App. filed March 11, 1901. A method of transmitting intelligence over an alternating current circuit by selecting for each signal or character a predetermined number of the current impulses and modifying them by changing their polarity, but otherwise maintaining their form and characteristics.

689,417. ELECTRIC TRUCK; T. F. Rowland, New York, N. Y. App. filed May 29, 1901. A truck upon which large welded cylinders can be rotated and also moved longitudinally to bring them into proper position with relation to welding mechanism.

689,426. PORTABLE TELEGRAPH KEY; C. Shirley, Brooklyn, N. Y. App. filed July 11, 1901. A key which can be placed in any position on a table and be operated without being attached to the table.

689,438. INTERRUPTER; T. W. Topham, Brooklyn, N. Y. App. filed July 30, 1901. (See Current News and Notes.)

689,445. RHEOSTAT; C. Wirt, Philadelphia, Pa. App. filed Oct. 13, 1900. The resistance is in the form of a ribbon of decreasing width from one end to the other.

689,450. VOLTAIC CELL; H. S. Amwake, Camden, N. J. App. filed Feb. 9, 1901. Details.

689,452. ELECTRIC CIRCUIT CONTROLLER; W. K. Bassford, Jr., Boundbrook, N. J. App. filed June 8, 1901. Controlling and reversing handles are each provided with certain projections so arranged that the projection on the controlling handle acts as a stop for the reverse handle in all of the "on" positions, but in the "off" position it is not a stop to the reverse handle.

689,453. LOCK FOR ELECTRIC CONTROLLERS; W. K. Bassford, Jr., Bound Brook, N. J. App. filed June 8, 1901. A modification of the preceding.

689,483. MAGNETIC ENGINE OR MOTOR; R. R. Gilman, Melrose, Mass. App. filed May 23, 1901. A permanent magnet is mounted to be moved by hand or otherwise, so that its poles may alternately retract and repel the poles of another permanent magnet or magnets mounted on an axis to produce motion.

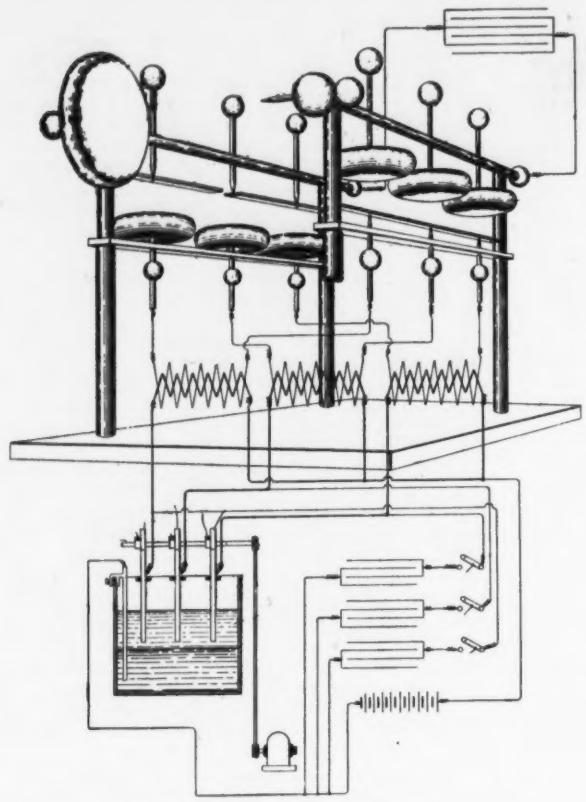
689,489. ELECTRICAL DEVICE; S. C. Harris, New York, N. Y. App. filed March 28, 1901. This device adapted for use as an indicator, clock, or cyclometer, embodies chiefly one or more stationary magnets, an oscillating magnet acting as an armature therefor and a superposed disk acting as an armature for the oscillating magnet and adapted to move therewith when the magnet is excited.

689,503. ELECTRIC TELEPHONE TRANSMITTER; A. M. Massari, Rome, Italy. App. filed Feb. 18, 1899. (See page 27.)

689,541. CONDUIT FOR ELECTRIC WIRES OR CABLES; T. Cunningham, Wenham, Mass. App. filed Dec. 26, 1899. The conduit is composed of worn-out boiler tubing, the ends squared and embraced by straps.

689,545. ELECTRIC RAILWAY; C. Hansel, New York, N. Y. App. filed Aug. 8, 1900. The third rail is mounted on supports which permit it to move relatively.

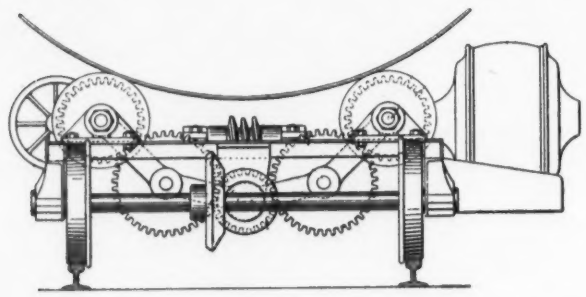
689,561. MEANS FOR MAGNETICALLY SEPARATING DIFFERENT SUBSTANCES FROM EACH OTHER; C. F. McKenna, New York, N. Y. App. filed Dec. 7, 1896. A magnet having pole pieces whose horizontal



689,096.—Electrical Apparatus.

cross section presents a concavity and whose central vertical cross section presents a convexity, in connection with which is used a circular rotary shell fitted to the pole pieces.

689,566.—APPARATUS FOR TRANSFORMING SINGLE AND MULTIPHASE ALTERNATING CURRENTS INTO CONTINUOUS CURRENTS AND INVERSELY; R. Rougé and G. Faget, Paris, France. App. filed April 6, 1900. (See Current News and Notes.)



689,417.—Electric Truck.

689,601. MERCHANDISE TRANSFER APPARATUS; A. W. Swanitz, Chicago, Ill. App. filed March 14, 1901. The apparatus consists of a car adapted to traverse a metallic floor in any direction whatever, the floor being one terminal of a circuit while the other is a ceiling against which a trolley rests. The car can thus be used to transfer goods to and from various locations on the floor.

689,613. ELECTRIC CABLE AND PROCESS OF MANUFACTURING SAME; G. E. Heyl-Dia, Warrington, Eng. App. filed May 16, 1901. An insulated cable of low capacity in which the first insulating covering of each conductor is of greater thickness along one side where related conductors of a pair touch one another.

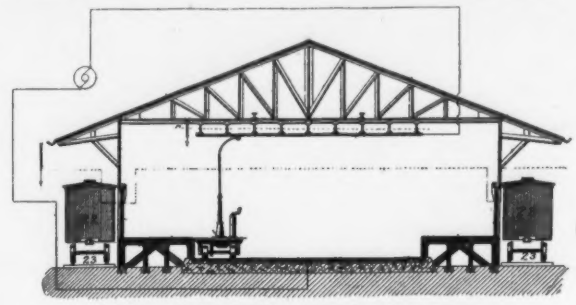
689,615. TROLLEY WIRE OR OTHER CONDUCTOR FOR ELECTRIC TRACTION; G. E. Heyl-Dia, Warrington, Eng. App. filed June 3, 1901. The conductor consists of a steel flexible web-portion having a copper facing on one or both edges.

689,631. TELEPHONE INDICATOR; S. J. Ballard, Los Angeles, Calif. App. filed April 11, 1900. (See page 27.)

689,653. ELECTRIC TRAMWAY OR STREET RAILWAY; W. B. Sayers, Glasgow, Scotland. App. filed Jan. 21, 1901. An open slot conduit arranged in the roadway parallel to the track rails and a return conductor that is supported within, but insulated from, the conduit and grounded at one point.

689,670. CUT OUT FOR CRANES; G. A. Hassel, McKeesport, Pa. App. filed July 27, 1901. A tripping shaft for releasing the lock that controls the contact is moved intermittently at each rotation of the shafting, and after a certain number of rotations the lock is tripped and the circuit of the motor opened.

689,674. MACHINE FOR EXTRACTING METAL FROM ORE; A. I. Irwin, Cripple Creek, Colo. App. filed Sept. 26, 1900. (See Current News and Notes.)



689,601.—Merchandise Transfer Apparatus.

689,683. ELECTRIC ELEVATOR; J. W. Moore, Newton Highlands, Mass. App. filed June 17, 1901. The speed and power are controlled by cutting in one or more sections of the field winding of a shunt machine.

689,698. BURGLAR AND FIRE ALARM; L. H. Williams, New York, N. Y. App. filed April 20, 1899. Details.

689,706. ELECTRIC RAILWAY SYSTEM; B. Cruvellier, Paris, France. App. filed May 3, 1901. A plunger thrust into a bed of metal filings forms one terminal of the circuit; the plunger is lifted by a magnet on the car to close the working circuit without disconnection from the metal filings.

689,711. ELECTRIC VISUAL SIGNAL APPARATUS; R. Einbigler, New York, N. Y. App. filed March 1, 1901. Details.

689,753. MULTIPLEX PRINTING TELEGRAPH; H. A. Rowland, Baltimore, Md. App. filed July 26, 1901. The invention is a complete system involving the use of alternating or other periodically varying line current, both for transmitting signals and producing synchronous motion.

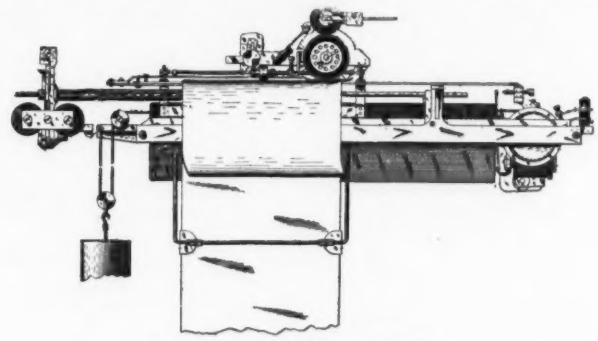
689,754. PAGE PRINTING MACHINE; H. A. Rowland, Baltimore, Md. App. filed Dec. 29, 1899. Covers the construction of the paper carriage and printing mechanism, and includes certain improvements upon the system described in the preceding patent.

689,776. ELECTRIC BATTERY; T. J. Bain, Cairo, Ill. App. filed July 8, 1901. The lower element is in the form of a cone, while the upper element has a downwardly projecting, non-conducting extension resting upon the top of the cone.

689,815. ELECTRIC RAILWAY; G. L. Fowler, New York, N. Y. App. filed July 18, 1900. Provides for the flexible mounting of a third rail.

689,816. ELECTRIC RAILWAY; G. L. Fowler, New York, N. Y. App. filed July 18, 1900. A modification of the preceding.

689,817. FIRE ALARM; A. W. Hansen and S. C. W. Harrison, Evanston, Ill. App. filed March 25, 1901. A number of circuit closing rods are held under restraint by radiating cords; when a cord is burned the alarm circuit is closed.



689,754.—Page Printing Machine.

689,826. AUTOMATIC COMPENSATORY ELECTRIC REEL; R. L. Montagu, Oroville, Calif. App. filed Oct. 17, 1900. A reel adapted to be erected upon a dredge or boat, with which to take up and pay out electric conductors extending from the shore to the boat as the boat changes its position.

689,830. LIMITER OR INTERRUPTER FOR ELECTRIC CIRCUITS; Ralph J. Patterson, Woburn, Mass. App. filed Dec. 29, 1900. Means for causing lamps to flicker when a house circuit is taking more than a predetermined amount of current. A magnet when operated upon by an excessive current intermittently introduces resistance into a circuit at short intervals throughout the duration of the abnormal conditions, thereby causing the lights to flicker.

689,836. ELECTRIC CUT-OUT; A. D. Wheeler, Hyde Park, Mass. App. filed March 2, 1901. Details.